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Stratospheric Ozone Depletion

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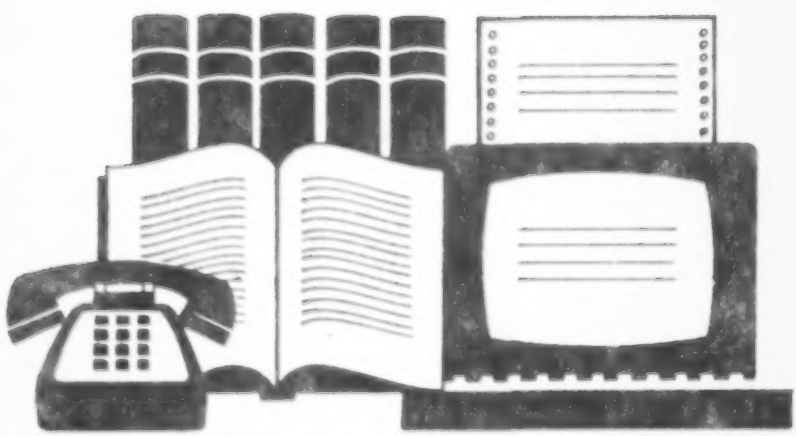

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This bibliography focuses solely on stratospheric ozone depletion. Global climate change, a related issue, is not within its scope. The first section contains an overview of stratospheric ozone issues. The second section, entitled "science", discusses atmospheric chemistry and dynamics, specifically trace gas emissions and ozone/UVB levels. The third section contains citations relating to risk assessment for humans and other organisms. Section IV includes information on domestic and international public policy. The fifth section outlines research on substitutes and alternatives for ozone-depleting substances. Worldwide participants in the Montreal Protocol are listed in the Appendix.

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STRATOSPHERIC OZONE DEPLETION

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STRATOSPHERIC OZONE DEPLETION

INTRODUCTION

This bibliography on Stratospheric Ozone Depletion was produced in support of EPA's Global Change Division, Office of Air and Radiation. The purpose of the bibliography is to assist the Global Change Division in making information available to the EPA staff, environmental organizations and the concerned public.

Stratospheric ozone protection is a global issue that requires international cooperation for the benefit of all nations. On January 1, 1989 an important international agreement, the Montreal Protocol, entered into force to reduce the use of ozone-depleting chemicals in participating countries (see Appendix). EPA actively worked with other U.S. agencies as well as national governments to ratify the Protocol and has issued domestic regulations implementing the mandates of the Protocol. Currently, EPA is sponsoring research to further assess the risks associated with ozone depletion. In 1990, parties to the Protocol will assemble to assess new scientific evidence. Based on this new information, the parties may vote to modify the Protocol.

The bibliography focuses solely on stratospheric ozone depletion. Global climate change, a related issue, is not within the scope of this bibliography. The first section contains an overview of stratospheric ozone issues. The second section, entitled "science", discusses atmospheric chemistry and dynamics, specifically trace gas emissions and ozone/UVB levels. The third section contains citations relating to risk assessment for humans and other organisms. Section IV includes information on domestic and international public policy. The fifth section outlines research on substitutes and alternatives for ozone-depleting substances. Worldwide participants in the Montreal Protocol are listed in the Appendix.

Citations were selected for their relevance to EPA information needs. The abstracts are the summaries of

the books, journal articles and reports cited, and provide an introductory overview to current literature. Most citations are from 1987 to the present.

The citations and abstracts were selected from commercial databases. The sources were noted by an alphabetic code enclosed in parenthesis at the end of each entry unless otherwise indicated in the citation. Those documents abstracted by the Global Change Division or Headquarters Library staff are marked (HQL). The other code abbreviations are listed below:

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Louisville, KY 40202

(CAN) Cancerlit
National Library of Medicine
MEDLARS Management
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Bethesda, MD 20894

(CPX) COMPENDEX PLUS
Engineering Information, Inc.
345 East 47th Street
New York, NY 10017

(EMB) Embase
User Education Officer
Elsevier Science Publishers /Excerpta Medica
52 Vanderbilt Avenue
New York, NY 10017

(ENV) Enviroline
Environment Information Center, Inc.
292 Madison Ave.
New York, NY 10017

(MED) MEDLINE
MEDLARS Management
8600 Rockville Pike
Bethesda, MD 20894

(NTIS) National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22041

(PAIS) Public Affairs Information Service
521 West 43rd Street
New York, NY 10036

Maria Tikoff, Program Analyst, Global Change Division, and Carol Brighton, a consultant for the Global Change Division, assisted in the development of this bibliography. They provided subject expertise and technical direction. This bibliography was compiled by Sheila A. Richard, Reference Librarian, EPA Headquarters Library.

For additional information, you may wish to contact the EPA Global Change Division at (202) 382-7750 or the EPA Headquarters Library (202) 382-5922. To obtain additional copies of this bibliography, contact the U.S. National Technical Information Service (NTIS) at (800) 336-4700 or write to them at the above address.

STRATOSPHERIC OZONE DEPLETION
BIBLIOGRAPHY

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I. OVERVIEW

The Montreal protocol on substances that deplete the ozone layer
Buxton, G.V.
Environ. Canada, Ottawa, Ont. K1A 0H3, Canada
81. APCA Annual Meeting & Exhibition Dallas, TX (USA)19-24 Jun 1988 81. APCA ANNUAL MEETING & EXHIBITION p. 145

Chlorofluorocarbons (CFCs) and brominated fluorocarbons (Halons) are non-toxic, non-flammable, non-corrosive chemicals used in critical areas such as refrigeration and fire protection. After an average residence time of 100 years, they are eventually broken down in the stratosphere and release chlorine or bromine. These act as catalysts in the destruction of ozone which in turn allows ever increasing amounts of cancer causing, crop-yield reducing, smog enhancing, ecosystem disrupting UV-B radiation to reach the earth's surface. International efforts to regulate these chemicals have been under way for several years and culminated in Montreal on September 16, 1987. The Treaty is now called the "Montreal Protocol on Substances that Deplete the Ozone Layer". (POL)

****

Changes in stratospheric ozone
Cicerone, R.J.
SCIENCE (WASH. VOL. 237, NO. 4810, pp. 35-42, Publ.Yr: 1987

The ozone layer in the upper atmosphere is a natural feature of the earth's environment. It performs several important functions, including shielding the earth from damaging solar ultraviolet radiation. Far from being static, ozone concentrations rise and fall under the forces of photochemical production, catalytic chemical destruction, and fluid dynamical transport. Human activities are projected to deplete substantially stratospheric ozone through anthropogenic increases in the global concentrations of key atmospheric chemicals. Human-induced perturbations may be occurring already. (POL)

****

Chlorofluorocarbons and the ozone layer
COHN JEFFREY P.
BIOSCIENCE, OCT 87, V37, N9, P647(4)

JOURNAL ARTICLE The chemical stability which renders chlorofluorocarbons (CFCS) so useful in many applications also threatens the stratospheric ozone layer. An increased thinning of the Antarctic O 3 profile, discovered in 1984,

added fuel to the debate over CFC use and effects. Indirect evidence for the CFC-O 3 link is mounting: computer simulations project a 10% O 3 loss by the middle of the next century if CFC use continues to grow at 3% per year. The incidence of skin cancers in the U.S. is rising and will likely continue to increase. EPA is considering issuing new regulations restricting CFC use, and the international community is also taking action to ban consumption of such compounds. (ENV)

****

The Ozone layer
CHEMECOLOGY, OCT 87, V16, N8, P2(3)

JOURNAL ARTICLE Stratospheric ozone forms a protective layer that filters out most of the ultraviolet radiation believed to be harmful to humans, plants and animals. Some scientists contend that this protective layer is thinning, and that up to 18% of the O 3 will be destroyed by the next century. Although there may not be conclusive evidence of persistent changes in global O3, there is evidence of reductions in O 3 above Antarctica. The most widely supported theory underlying this reduction blames chlorofluorocarbons (CFC) for O 3 depletion. Whereas carbon dioxide, methane, and other atmospheric gases tend to enhance O 3 formation, CFCs and nitrogen oxides destroy its. UNEP is leading negotiations to freeze production of CFCs. However, this move may not be economically feasible until suitable substitutes for CFCs are found. (ENV)

****

Protecting Life on Earth: Steps to Save the Ozone Layer
Shea, Cynthia Pollock.
Worldwatch Paper 87, December 1988.

Provides a brief history of the ozone depletion issue, discusses the effects of increased UV-B and emission reduction policies. (HQL)

****

The Ozone layer
United Nations Environment Programme (UNEP).
GEMS Environment Library No. 2 1987

Includes sections on the scientific background for ozone depletion, effects of increased ultraviolet radiation on society, and implications for policy. (HQL)

****

II. SCIENCE

A. OZONE/UVB LEVELS

Comparison of In situ Stratospheric Ozone Measurements Obtained during the MAP/GLOBUS 1983 Campaign (Final rept.)

Aimedieu, P.; Matthews, W.A.; Attmannspacher, W.; Hartmannsgruber, R.; Cisneros, J.
Centre National de la Recherche Scientifique, Verrieres-le-Buisson (France). Service d'Aeronomie.
Sponsor: Deutscher Wetterdienst, Hohenpeissenberg (Germany, F.R.). Meteorologisches Observatorium.; National Oceanic and Atmospheric Administration, Boulder, CO. Air Resources Lab.; National Aeronautics and Space Administration, Houston, TX. Lyndon B. Johnson Space Center. c1987 24p

An instrumented gondola, carrying five types of in situ ozone sensors, was flown twice as part of the MAP/GLOBUS 1983 campaign. It is shown that when the individual sondes are carefully prepared and preflight calibrated, they produce data that agree to within a 5% uncertainty throughout the middle stratosphere. The individual measurement techniques are described and the error budgets given as well as the possible reasons for discrepancies in the ozone values at higher and lower altitudes. The techniques used include two electrochemical sondes, ultraviolet absorption photometry, olefin chemiluminescense and indigo decolorization. (NTIS)

****

Relation of Antarctic 100 mb temperature and total ozone to equatorial QBO, equatorial SST, and sunspot number, 1958-87

ANGELL, J. K.
(NOAA, Air Resources Laboratory, Silver Spring, MD)
Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 915-918. 14 Refs.

Year-to-year changes in Antarctic 100-mb temperature values and total-ozone trends for the spring months of September, October, and November (SON) of the 30 years between 1958 and 1987 were compared with each other and with year-to-year changes in the SON values of SST (reflecting El Nino) and in equatorial 50-mb temperature (reflecting the quasi-biennial oscillation, QBI) in the same period. During these 30 years, the levels of correlation between year-to-year changes in the values of Antarctic 100-mb and total ozone and in the values of Antarctic 100-mb and equatorial 500-mb temperature were significant. There was also a significant correlation at the 5-percent level between year-to-year changes in the Antarctic total ozone and the year-to-year changes in equatorial 50-mb temperature and equatorial SST if the latter two quantities were considered jointly (multiple correlation). Some

evidence was found of an increase in springtime values of Antarctic 100-mb temperature (and total ozone) with an increase in the sunspot number when the equatorial QBO was the east-wind, but not when in the west-wind, phase. (AER)

****

The Endangered ozone layer: new theories on ozone depletion
BRASSEUR GUY
FREE UNIV OF BRUSSELS, BELGIUM,
ENVIRONMENT, JAN-FEB 87, V29, N1, P6(13)

JOURNAL ARTICLE BECAUSE OF ITS IMPORTANCE TO THE GLOBAL ENVIRONMENT AND THE THREAT OF GRADUAL DESTRUCTION, OZONE IS BEING MONITORED CONTINUOUSLY IN DIFFERENT REGIONS OF THE WORLD. OBSERVATIONS OF O 3 DISTRIBUTION AND OCCURRENCE ARE DISCUSSED, AND PERTURBATIONS OF THE O 3 LAYER BY CARBON DIOXIDE, METHANE, NITROUS OXIDE, OR CHLOROFLUOROCARBONS ARE EXPLAINED. SEVERAL ATTEMPTS HAVE BEEN MADE TO EXPLAIN THE RAPID DECREASE IN THE SPRINGTIME O 3 COLUMN ABUNDANCE OVER ANTARCTICA. NOAA RESEARCHERS SUGGEST THAT THE CHLORINE RESERVOIRS AND THE NITROGEN OXIDES ARE DESTROYED INSIDE THE POLAR STRATOSPHERIC CLOUDS OBSERVED OVER ANTRACTICA IN WINTER. OTHERS BELIEVE THAT O 3 COULD HAVE BEEN DESTROYED BY INCREASED AMOUNTS OF NOX PRODUCED IN THE THERMOSPHERE DURING THE EXCEPTIONAL MAXIMUM OF THE LAST SOLAR CYCLE AND INJECTED INTO THE LOWER STRATOSPHERE. THE PLAUSIBILITY OF OTHER EXPLANATIONS, INCLUDING DYNAMICAL THEORIES, IS CONSIDERED. (ENV)

****

Formation of the Antarctic Ozone Hole by the CIO Dimer Mechanism
Barrett, J.W.; Solomon, P.M.; Zafra, R.L.; Jaramillo, M.;
Emmons, L. and Parrish, A.
Nature, Vol. 336, December 1, 1988. pp.455-458.

The formation of OCIO at night, provided strong evidence that the evolution of the Antarctic ozone hole is chemically driven by chlorine. The report shows that both the rate and altitude range of ozone depletion can be quantitively accounted for by a mechanism in which the CIO dimer is the important intermediary in the catalytic destruction of ozone. An alternative bromine mechanism appears capable of contributing only 5-15% to the ozone loss rate. (HQL)

****

Stratospheric response to trace gas perturbations: Changes in ozone and temperature distributions

Brasseur, G.; Hitchman, M.H.

Belgian Inst. Space Aeron., 1180 Brussels, Belgium

SCIENCE (WASH. VOL. 240, NO. 4852, pp. 634-637, Publ.Yr: 1988

An increase in CFCs caused ozone depletion in the model, with the largest losses near the stratopause and, in the vertical mean, at high latitudes. Increased CO sub(2) caused ozone amounts to increase through cooling, with the largest increases again near 45 kilometers and at high latitudes. This CO sub(2)-induced poleward increase reduced the CFC-induced poleward decrease. Poleward and downward ozone transport played a major role in determing the latitudinal variation in column ozone changes. (POL)

****

Two-dimensional modelling of the Antarctic lower stratosphere

CHIPPERFIELD, M.P.; PYLE, J.A. (Cambridge University, England)

Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 875-878. Research supported by the Department of the Environment of England.

Publication Date: Aug. 1988

A two-dimensional radiative-dynamical-chemical model was used to study some aspects of Antarctic ozone depletion. While many aspects of the preconditioning of the vortex are reproduced by simply reducing the horizontal diffusion during the Antarctic winter and early spring, significant problems remain. The lack of knowledge of the meridional circulation throughout the year represents a serious limitation. When a springtime ozone depletion is imposed on the model in the Antarctic, the effect of the depletion is confined mainly to high southern latitudes. The consequent changes in radiative transfer lead to lower temperatures in the lower polar atmosphere during spring, with some smaller increases in temperature above about 20mb. (AER)

****

Total ozone by lunar Dobson observation at Syowa, Antarctica

CHUBACHI, SHIGERU (Meteorological Research Institute, Tsukuba, Japan); KAJIWARA, RYOICHI (Aerological Observatory, Tsukuba, Japan)

Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 905, 906.

Publication Date: Aug. 1988

In this paper, the accuracy of total ozone measurements by lunar Dobson observation at Syowa, Antarctica is discussed. The changes in total ozone and vertical ozone profiles before and after January 1982 are also described. (AER)

****

South Pole lidar: Brief description of the instrument

FIOCCO, G.; FUA, D.

Rome Univ. (Italy). Dipt. di Fisica.

Publication Date: Feb. 1988 17P.

Publication Note: Sponsored by NOAA and the CNR, Italy

The lidar system installed in the clean air facility at the Amundsen-Scott South Pole Station is described. The lidar utilizes a Nd YAG laser with 2nd harmonic generation, a 50 cm diameter telescope, and two-channel detection; the data are sent via ATS-3 and the electronic mail network for further analysis. It can measure vertical profiles of the volume backscattering cross section of the atmosphere at wavelength 532 nm, in a height region extending from the boundary layer to the upper stratosphere; from such data it is possible to infer the molecular and aerosol concentration of air, and derive quantities such as atmospheric temperature. The noise background produced by the scattered solar radiation is expected to change with the solar elevation angle and so the signal to noise ratio should progressively improve with the onset of the polar night. The information obtained is expected to be relevant to studies of atmospheric radiation, structure, and composition, in the context of climate research, and may help in the understanding of the mechanisms involved in the Antarctic ozone depletion process. In the polar winter the lidar has distinct advantages when compared to other remote sensing techniques. (AER)

****

Non-seasonal changes in total column ozone from satellite observations, 1970-86

HEATH, DONALD F. (NASA, Goddard Space Flight Center, Greenbelt, MD)

National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

Nature (ISSN 0028-0836), vol. 332, March 17, 1988, p. 219-227. Publication Date: Mar. 1988 29 Refs.

Analyses of nonseasonal changes in total column ozone from satellite observations during the period 1970-86 suggest, when combined with analyses of Dobson network data, that the largest reduction in global ozone since 1959 occurred between 1978 and 1986. The existence of an Arctic region of enhanced ozone depletion with similar but less pronounced

characteristics of the Antarctic region is described. Before 1983 large rates of decrease were confined to high latitudes, subsequently regions of large rates of ozone depletion have appeared at midlatitudes. (AER)

****

Evidence of Arctic Ozone Destruction
Kerr, Richard A.
Science, Vol. 240, May 27, 1988. pp.1144-1145.

The same chlorine compounds that first pointed to the destruction of ozone by chlorofluorocarbons in the Antarctic hole has now been found over the Arctic. (HQL)

****

Stratospheric ozone is decreasing
KERR RICHARD A.
SCIENCE, MAR 25, 88, V239, N4847, P1489(3)

JOURNAL ARTICLE THE AUTHORITATIVE OZONE TRENDS PANEL, THE CREATION OF NASA, NOAA, FAA, UNEP, AND THE UN WORLD METEOROLOGICAL ORG., HAS ANNOUNCED THAT STRATOSPHERIC O 3 HAS INDEED DECREASED, AT SOME TIMES AND PLACES SEVERAL TIMES FASTER THAN PREDICTED. THE DISCOVERY OF THE GLOBAL O 3 DECREASE COMES ON THE HEELS OF THE RECENT RECOGNITION THAT CHLOROFLUOROCARBONS CREATE THE ANTARCTIC O 3 HOLE EVERY OCTOBER THROUGH REACTIONS MEDIATED BY ICE PARTICLES FORMED AT THE LOWEST TEMPERATURES OF THE STRATOPSHERE. THE PANEL'S DISCOVERY OF UNEXPECTEDLY LARGE O 3 DECREASES DURING WINTER HINTS THAT SUCH ICE-MEDIATED CHEMISTRY MAY PLAY A ROLE IN THE GLOBAL DECREASE AS WELL. (ENV)

****

Airborne Antarctic Ozone Experiment 1987: The Nimbus-7 Toms Data Atlas
Krueger, A.J.; Ardanuy, P.E.; Sechrist, F.S.; Penn, L.M.; Larko, D.E.
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
Corp. Source Codes: 013129001; NC999967
Report No.: NAS 1.61:1201; REPT-88B0107; NASA-RP-1201
Mar 88 246p

Total ozone data taken by the Nimbus-7 Total Ozone Mapping Spectrometer (TOMS) played a central role in the successful outcome of the 1987 Airborne Antarctic Ozone Experiment. The near-real-time TOMS total ozone observations were supplied within hours of real time to the operations center in Punta Arenas, Chile, over a telecommunications network designed

specifically for this purpose. The TOMS data preparation and method of transfer over the telecommunications links are reviewed. This atlas includes a complete set of the near-real-time TOMS orbital overpass data over regions around the Palmer Peninsula of Antarctica for the period of August 8 through September 29, 1987. Also provided are daily polar orthographic projections of TOMS total ozone measurements over the Southern Hemisphere from August through November 1987. In addition, a chronology of the salient points of the experiment, along with some latitudinal cross sections and time series at locations of interest of the TOMS total ozone observations are presented. The TOMS total ozone measurements are evaluated along the flight tracks of each of the ER-2 and DC-8 missions during the experiment. The ozone hole is shown here to develop in a monotonic progression throughout late August and September. The minimum total ozone amount was found on 5 October, when its all-time lowest value of 109 DU is recorded. The hole remains well defined, but fills gradually from mid-October through mid-November. The hole's dissolution is observed here to begin in mid-November, when it elongates and begins to rotate. By the end of November, the south pole is no longer located within the ozone hole. (NTIS)

****

Antarctic ozone depletion caused by heterogeneous photolysis of halogenated hydrocarbons

Krueger, Bernd C.; Wang, GuiQin; Fabian, Peter
Max-Planck-Inst fuer Aeronomie, Linday, West Ger
Source: Geophysical Research Letters v 14 n 5 May 1987 p 523-526 Publication Year: 1987

Corresponding to measurements made in the Arctic, assumptions have been made on the atmospheric concentrations of reactive halogenated hydrocarbons in Antarctica. These concentrations have been used in a one-dimensional photochemical model calculation carried out for Antarctic conditions. When the photolysis rates of these compounds are increased, which is likely to be expected due to an acceleration by heterogeneous photolysis, total ozone columns are calculated well in agreement with the recently observed low Antarctic ozone values. (CPX)

****

Automated Ozone Photometer

LaVelle, J. R.

National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.

Corp. Source Codes: 019045001; NC473657

Report No.: NAS 1.15:100064; A-88079; NASA-TM-100064

Feb 88 11p

A photometer capable of automatically measuring ozone concentration data to very high resolution during scientific research flights in the Earth's atmosphere was developed at NASA Ames Research Center. This instrument was recently deployed to study the ozone hole over Antarctica. Ozone is detected by absorbing 253.7-nm radiation from an ultraviolet lamp which shines through the sample of air and impinges on a vacuum phototube. A lower output from the phototube indicates more ozone present in the air sample. The photometer employs a CMOS Z80 microprocessor with an STD bus system for experiment control, data collection, and storage. Data are collected and stored in nonvolatile memory for experiments lasting up to 8 hr. Data are downloaded to a portable ground-support computer and processed after the aircraft lands. An independent single-board computer in the STD bus also calculates ozone concentration in real time with less resolution than the CMOS Z80 system, and sends this value to a cockpit meter to aid the pilot in navigation. (NTIS)

****

Rocoz-a (Improved Rocket Launched Ozone Sensor) for Middle Atmosphere Ozone Measurements

Lee, H.S. ; Parsons, C.L.

National Aeronautics and Space Administration, Wallops Island, VA. Wallops Station.

Corp. Source Codes: 018684001; NE157849

c1987 8p

An improved interference filter based ultraviolet photometer (ROCOZ-A) for measuring stratospheric ozone is discussed. The payload is launched aboard a Super-Loki to a typical apogee of 70 km. The instrument measures the solar ultraviolet irradiance as it descends on a parachute. The total cumulative ozone is then calculated based on the Beer-Lambert law. The cumulative ozone precision measured in this way is 2.0% to 2.5% over an altitude range of 20 and 55 km. Results of the intercomparison with the SBUV overpass data and ROCOZ-A data are also discussed. (NTIS)

****

Antarctic measurements of ozone by SAGE II in the spring of 1985, 1986, and 1987

MCCORMICK, M.P. (NASA, Langley Research Center, Hampton VA); LARSEN, J.C. (ST Systems Corp., Hampton, VA)
National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 907-910.
Publication Date: Aug. 1988 7 Refs.

This paper presents a three-year (1985, 1986, and 1987) comparison of ozone profiles within the southern polar vortex for September and October, using data obtained by the Stratospheric Aerosol and Gas Experiment II. It was found that, by the first half of October 1986, daily minima in total ozone showed a moderate recovery of 5-7 percent relative to 1985, whereas in 1987, a significant drop of 15 percent from the 1985 minima was observed. The interannual variability of total ozone, temperature, and temperature area or vortex size were found to display a quasi-biennial oscillation (QBO) signal similar to that established by Garcia and Solomon (1987) for Antarctica. Since the 1985 and 1987 years displayed the same QBO phase (westerly) and the 1987 depletion was greater than that of 1985, it is concluded that the long-term secular ozone trend continues to be downward. (AER)

****

The Morphology and meteorology of Southern Hemisphere spring total ozone mini-holes

NEWMAN, PAUL A. (Applied Research Corp., Landover, MD); LAIT, LESLIE R.; SCHOEBERL, MARK R. (NASA, Goddard Space Flight Center, Greenbelt, MD) Applied Research Corp., Landover, Md.
Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 923-926. NASA-supported research.
Publication Date: Aug. 1988 5 Refs.

Two case studies of miniholes, rapid ozone decreases, noted in 1987 near the base of the Antarctic peninsula are studied using a digital filter. The results show a strong correlation of the total ozone minihole with a temperature minihole (a negative temperature perturbation), and a westward tilt with altitude of the temperature minihole. The ozone minihole is phase shifted both slightly to the east of a high in the geopotential height field and slightly to the west of a local low in the Ertel potential vorticity field. (AER)

****

October Lower Stratospheric Antarctic Temperature and Total Ozone from 1979-1985. Abstract Only

Newman, P.A.; Schoeberl, M.R.

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.

Corp. Source Codes: 013129001; NC999967

Dec 87 2p

During October, from 1979 to 1985, Southern Hemisphere daily plots of TOMS total ozone and lower stratospheric temperature are shown to be strongly correlated. The same result is found for the monthly averages. Additionally, these data reveal strong wave events during the ozone hole period. October zonal means of TOMS total ozone and NMC temperature are well correlated from year to year, and both are decreasing. Finally, the mid-latitude temperature maximum is found to be radically cooler in 1985 than in either 1979 (a dynamically active year) or in 1980 (a dynamically quiescent year). (NTIS)

****

Antarctic Ozone Depletion and Ozone Measurements in Brazil

Sahai, Y.; Kane, R.P.; Teixeira, N.R.

Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Corp. Source Codes: 058511000; IO601891

Sponsor: National Aeronautics and Space Administration, Washington, DC. Report No.: INPE-4236-PRE/1111

Jul 87 15p

Recent satellite and ground based observations of depletion of atmospheric ozone in Antarctic region during spring (October) have attracted world wide attention of scientists due to possible global environmental implications. Measurements of the total atmospheric ozone started at this Institute at Cachoeira Paulista (22.7 deg S, 45.0 deg W), SP, using a Dobson spectrophotometer in 1974. In 1978, another station was added at Natal (5.8 deg S, 35.2 deg W), RN, in collaboration with the National Oceanic and Atmospheric Administration, Boulder, Co. Both the stations carry out regular total ozone measurements and with Huancayo (12.0 deg S, 65.3 deg W), Peru, and Buenos Aires (34.5 deg S, 48.7 deg W), Argentina, form a chain of four stations in the South America. A comparative study of the ozone measurements in Brazil in relation to other South America and Antarctic stations is presented. It is shown that the Antarctic ozone depletion does not extend to the middle and low latitudes. (NTIS)

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Biologically effective ultraviolet radiation: surface measurements in the United States, 1974 to 1985

Scotto J; Cotton G; Urbach F; Berger D; Fears T

Biostatistics Branch, National Cancer Institute, Bethesda, MD 20892. Science (UNITED STATES) Feb 12 1988, 239 (4841 Pt 1) p762-4, ISSN 0036-8075

Recent reports of stratospheric ozone depletion have prompted concerns about the levels of solar ultraviolet radiation that reach the earth's surface. Since 1974 a network of ground-level monitoring stations in the United States has tracked measurements of biologically effective ultraviolet radiation (UVB, 290 to 330 nanometers). The fact that no increases of UVB have been detected at ground levels from 1974 to 1985 suggests that meteorological, climatic, and environmental factors in the troposphere may play a greater role in attenuating UVB radiation than was previously suspected. (MED)

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Simultaneous measurement of UV radiation received by the biosphere and total ozone amount

STAMNES, K.; HENRIKSEN, K.; OSTENSEN, P.

(Nordlysobservatoriet, Tromso, Norway)

Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 784-787. Research supported by the Norges Almenvitenskapelige Forskningsrad.

Publication Date: Aug. 1988 11 Refs.

Contract No.: NSF DPP-86-18706

The results of ground-based spectral measurements with a double monochromator of solar UV irradiance in the Arctic were used to derive the atmospheric ozone content. The double monochromator allowed separation of the diffuse and direct components of the radiation, and the global (i.e., direct plus diffuse) irradiance. The column density of atmospheric ozone derived by fitting calculated UV irradiances to the measurements were shown to be in basic agreement with the ozone amounts inferred by a nearby Dobson spectrometer, demonstrating the feasibility of determining simultaneously the atmospheric ozone abundances and the UV radiation transmitted through the atmosphere. It is suggested that a combination of UV measurements and appropriate radiative transfer modeling be used to assess the effects of other environmental parameters, such as clouds, aerosols, and ground albedo, on the transimitted UV irradiance. (AER)

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TOMS (Total Ozone Mapping Spectrometer): The Antarctic Ozone Hole and Ozone Trends. Abstract Only

Stolarski, R. S.

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.

Corp. Source Codes: 013129001; NC999967

Dec 87 3p

The Total Ozone Mapping Spectrometer (TOMS) instrument aboard Nimbus 7 has proved invaluable for the investigation of the recent rapid decline in the springtime total ozone over the Antarctic. The principle problem discussed is that of observing the atmosphere over long periods of time to determine whether or not trends and/or slow oscillations are taking place. Total ozone is an excellent summary parameter for the state of the stratosphere. It responds to temperature changes, and in the long term, is expected to respond to chemical changes. Thus, when changes take place in total ozone, such as the springtime Antarctic decrease it is a clear indication of an important problem, both because of environmental potential and scientific importance. TOMS is actually an overkill for this problem. Significantly more data is taken than is necessary. Tests have shown that maps produced on a 2 by 4 degree grid are essentially equivalent to those produced from the entire gridded data set. Because the critical aspect of the search for changes in ozone is continuous data, reflight of a polar orbiting TOMS is important. Included in the flight should be a stratospheric temperature sensor and, if possible, a modification to obtain some ozone altitude information. A critical aspect of the problem is timeliness of the data. This is the only drawback of the existing TOMS. It is expected that in the very near future the processing will be done within two weeks of real time. This is critical to the process of discovery of phenomena such as the Antarctic ozone hole. (NTIS)

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Review of the results of the Antarctic ozone expedition: hearing, October 29, 1987.

United States. House. Com. on Science, Space, and Tech.

'88 iii+488p, bibls il tables diag charts

SERIES: 100th Cong., 1st sess.; (Pubn.) no. 77; SD cat. no. Y 4.Sci 2:100/77;

Includes the 234-page report, "Regulatory impact analysis: protection of stratospheric ozone," prepared by the Stratospheric Protection Program, Environmental Protection Agency. (PAIS)

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Microwave limb sounder

Waters, J. W.

JPL, Pasadena, CA, USA

Conference Title: IGARSS '87. Remote Sensing: Understanding the Earth as a System.

Conference Location: Ann Arbor, MI, USA Conference Date: 1987 May 18-21 Sponsor: IEEE Geoscience & Remote Sensing Soc, New York, NY, USA; Int Union of Radio Science, Commission F, Brussels, Belg

E.I. Conference No.: 10379

Source: Digest - International Geoscience and Remote Sensing Symposium (IGARSS) 1987. Publ by IEEE, New York, NY.

Summary form only given, as follows. Observations of microwave thermal emission from the atmospheric limb provide measurements of many important stratospheric and mesospheric species. Particularly valuable are the measurements of key chemical radicals involved in depletion of stratospheric ozone. A microwave limb sounder experiment is now under development for the UARS upper atmospheric research satellite. A similar experiment for the Earth Observing System (EOS) will provide continuity of the UARS measurements and also additional important measurements for which technology was not available for UARS. (CPX)

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Present State of Knowledge of the Upper Atmosphere 1988: An Assessment Report

Watson, R.T.; Prather, M.J.; Kurylo, M.J.

National Aeronautics and Space Administration, Washington, DC.

Corp. Source Codes: 011249000; NC452981

Report No.: NAS 1.61:1208; NASA-RP-1208

Jun 88 203p

This document was issued in response to the Clean Air Act Amendments of 1977, Public Law 95-95, mandating that NASA and other key agencies submit biennial reports to Congress and EPA. NASA is to report on the state of our knowledge of the upper atmosphere, particularly the stratosphere. This is the sixth ozone assessment report submitted to Congress and the concerned regulatory agencies. Part 1 contains an outline of the NASA Upper Atmosphere Research Program and summaries of the research efforts supported during the last two years. An assessment is presented of the state of knowledge as of March 15, 1988 when the Ozone Trends Panel, organized by NASA and co-sponsored by the World Meteorological Organization, NOAA, FAA and the United Nations Environment Program released an executive summary of its findings from a critical in-depth study involving over 100 scientists from 12 countries. Chapter summaries of the International Ozone Trends Panel

Report form the major part of this report. Two other sections are Model Predictions of Future Ozone Change and Chemical Kinetics and Photochemical Data for Use in Stratospheric Modeling. Each of these sections and the report in its entirety were peer reviewed. (NTIS)

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International Effort to Examine Arctic Ozone Loss Gets Under Way
Zurer, Pamela S.
Chemical and Engineering News, January 2, 1089. pp. 30-32.

U.S. and European scientists aboard NASA aircraft to look for signs implicating CFC chlorine as Soviet scientists also gather and share data. (HQL)

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Studies on Ozone Destruction Expand Beyond Antarctic
Zurer, Pamela S.
Chemical and Engineering News, May 30, 1988. pp. 16-25.

With proof that chlorine from CFC's destroys Antarctic ozone, scientists now find signs of perturbed chlorine chemistry in the Arctic. (HQL)

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B. ATMOSPHERIC DYNAMICS AND CHEMISTRY

Ozone destruction and photochemical reactions at polar sunrise in the lower Arctic atmosphere

BARRIE, LA; BOTTENHEIM, JW (Department of the Environment, Atmospheric Environment Service, Downsview, Canada); SCHNELL, RC (Cooperative Institute for Research in Environmental Sciences, Boulder, CO); CRUTZEN, PJ (Max-Planck-Institut fuer Chemie, Mainz, Federal Republic of Germany; Chicago, University, IL); RASMUSSEN, RA (Oregon Graduate Center, Beaverton)

Nature (ISSN 0028-0836), vol. 334, July 14, 1988, p. 138-141. Publication Date: Jul. 1988 29 Refs.

Recent ground-level observations from the Canadian baseline station at Alert (82.5 deg N, 62.3 deg W) and from aircraft are studied which show that ozone destruction is occurring under the Arctic surface radiation inversion during March and April as the sun rises. The destruction might be linked to catalytic reactions of BrO(x) radicals and the photochemistry of bromoform, which appears to have a biological origin in the Arctic Ocean. This may clarify previously unexplained regular springtime occurrences of ozone depletion at ground level in a 10-year data record at Barrow, Alaska, as well as peaks in aerosol bromine observed throughout the Arctic in March and April. (AER)

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Radiative heat transfer to chemically reacting flow between concentric rotating spheres

BESTMAN, A.R.

International Centre for Theoretical Physics, Trieste (Italy). Publication Date: May 1987 21P.

Report No.: DE88-702538; IC-87/103

The flow between two hot concentric rotating spheres in the presence of chemical reaction is used to model the depletion of ozone by nitrogen and chlorine compounds in the middle atmosphere. Even the most modest of calculations reveal that a 6 percent depletion of ozone could very easily be achieved as a result of overburning or extensive use of fertilizers for agriculture. (AER)

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Changes in stratospheric ozone: Observations and theories

BRASSEUR, GUY; SIMON, PAUL C.

Institut d'Aeronomie Spatiale de Belgique, Brussels.

Publication Date: 1988 41P.

Presentation Note: Presented at the Deutsche Gesellschaft fuer Chemisches Apparatewesem, Chemische Technik und Biotechnologie e.V Conference, Frankfurt, Fed. Republic of Germany, Dec. 1987 and the Conf. on Air Pollution and its Effects on the Environ., Padua, Italy

Report No.: AERONOMICA-ACTA-A-334-1988; ISSN-0065-3713; ETN-88-93074

Observations used to derive a possible ozone trend over the last decade, and model simulations of ozone changes are reviewed. Theories to explain ozone depletion over Antarctica especially during springtime are presented. Recent observations show unambiguously that elevated amounts of ClO are present over Antarctica in the lower stratosphere during springtime. It is believed that the release of active chlorine is activated by the presence of polar stratospheric clouds. (AER)

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The Stability and photochemistry of dimers of the ClO radical and implications for Antarctic ozone depletion

Cox, R.A.; Hayman, G.D.

Eng. Sci. Div., Harwell Lab., Didcot, Oxon OX11 0RA, UK

NATURE VOL. 332, NO. 6167, pp. 796-800, Publ.Yr: 1988

Measurements of the ultraviolet spectrum of the Cl sub(2)O sub(2) molecule formed at temperatures in the range 203-300 K by recombination of ClO radicals are reported. The equilibrium constant for the reaction has been determined and the products of photolysis of Cl sub(2)O sub(2) at 254 nm investigated. The main photodissociation pathway for Cl sub(2)O sub(2) probably produces Cl atoms and chlorine peroxy radicals, as assumed in calculation of the ozone loss by the ClO and Cl sub(2)O sub(2) catalytic cycle in the Antarctic stratosphere. (ENV)

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Comparative morphology of the vertical ozone profile in the Antarctic spring

GARDINER, BRIAN G. (NERC, British Antarctic Survey, Cambridge, England) Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 901-904. Research supported by the Chemical Manufacturers Association and Department of the Environment of England.

Publication Date: Aug. 1988

Soundings of the vertical distribution of Antarctic ozone are used here to demonstrate significant features in the development of the spring ozone depletion phenomenon. The process is already underway in the last week of August and has its maximum effect in the second week of October. The active period of ozone destruction therefore appears to last for some seven weeks. There is a minimum in ozone mixing ratio as a function of pressure from the spring equinox onwards. When the depletion is fully developed, the affected region extends from 150 mbar to 20 mbar. Laminar structure is frequently observed before, during, and after the period of maximum depletion, implying that it is generally a consequence of wind shear. Substantial depletion is still present on November 23. (AER)

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Kinetics of the BRO + CLO reaction and implications for stratospheric ozone

HILLS ALAN J.; CICERONE RALPH J.; CALVERT JACK G.; BIRKS JOHN W. UNIV OF COLORADO
NATURE, JUL 30, 87, V328, N6129, P405(4)

RESEARCH ARTICLE THE GAS-PHASE REACTION BETWEEN BROMIDE AND CHLORINE MONOXIDE HAVE BEEN PROPOSED AS A POTENTIALLY FAST, SYNERGISTIC MECHANISM OF STRATOSPHERIC OZONE DESTRUCTION. IT HAS BEEN ADVANCED AS A CONTRIBUTING FACTOR TO ANTARCTIC SPRINGTIME O 3 COLUMN LOSSES OF 40% DURING 1960-85. A MAJOR UNCERTAINTY IN UNDERLYING THEORIES HAS BEEN THE RATE CONSTANT AND PRODUCT DISTRIBUTION OF THE BRO + CLO REACTION AS A FUNCTION OF TEMPERATURE. THE FIRST DIRECT MEASUREMENT OF THESE PARAMETERS IS REPORTED. THIS REACTION COULD ACCOUNT FOR A LARGE FRACTION OF THE SPRINGTIME O 3 DEPLETION OVER ANTARCTICA AND PROVIDE A SOURCE OF CHLORINE DIOXIDE OF SUFFICIENT MAGNITUDE TO EXPLAIN THE RECENT MEASUREMENTS OF THIS SPECIES IN THE ANTARCTIC STRATOSPHERE. (ENV)

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Assessing the Risks of Trace Gases That Can Modify the Stratosphere. Volume 7. Technical Support Documentation Atmospheric Science Papers

Hoffman, J.S.
Environmental Protection Agency, Washington, DC. Office of Air and Radiation.
Corp. Source Codes: 031287620
Dec 87 214p

The document is one of a series that examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. It includes 5 atmospheric

science papers on atmospheric modeling. Photochemistry model sensitivity to chlorine perturbations, ozone perturbations in the LLNL one-dimensional model, Monte Carlo uncertainty analysis of stratospheric ozone, ozone changes of the troposphere and stratosphere, and ultraviolet solar flux incident on the biosphere are discussed. (NTIS)

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Response of a general circulation model to a prescribed Antarctic ozone hole

KIEHL, J.T.; BOVILLE, BYRON A.; BRIEGLEB, BRUCE P. (National Center for Atmospheric Research, Boulder, CO)
Nature (ISSN 0028-0836), vol. 332, April 7, 1988, p. 501-504.
Publication Date: Apr. 1988 15 Refs.

Model simulation of the 'ozone hole' observed in Austral springtime indicates that the ozone depletion leads to a temperature decrease in the lower Antarctic stratosphere of about 5 K in mid-October. The temporal evolution of the thermal balance in the control shows that weak upward motion occurs by mid-September and shows the temperature tendency is dominated by the net radiative heating through late September to November. When the ozone hole is imposed, downward motion persists through September to mid-October and the final warming in November is postponed. (AER)

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Heterogeneous reactions of N2O5 with H2O and HCl on ice surfaces -Implications for Antarctic ozone depletion

LEU, MING-TAUN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena)
Jet Propulsion Lab., California Inst. of Tech., Pasadena.
Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 851-854.
Publication Date: Aug. 1988 22 Refs.

This paper reports on the measurements of reaction probabilities for heterogeneous reaction of N2O5 with H2O and HCl on ice surfaces at 195 K, using a fast-flow reactor coupled with a quadrupole mass spectrometer. The reaction probability for N2O5 on pure-water ice was found to be 0.028 + or - 0.011, with nitric acid in the solid phase as the sole product. In the presence of HCl in ice, the probability of N2O5 reaction was enhanced (to 0.037); the reaction produced, besides solid-phase nitric acid, ClNO2 and ClONO which were released into the gas phase within a few milliseconds. The latter two compounds can be readily photolyzed in the austral spring to form active chlorine which would remove stratospheric ozone. It is suggested that, since the polar

stratospheric clouds are believed to contain HCl-ice mixture on the surface, the reactions of N2O5 on H2O/HCl particles is a major factor in the Antarctic springtime ozone depletion. (AER)

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Ozone Depletion at the Poles: The Hole Story Emerges
Levi, Barbara G.
Physics Today, July 1988, p. 17-21.

Describes the mechanisms responsible for inducing ozone depletion and the methods used to monitor it. (HQL)

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Stratospheric sulphate production and the photochemistry of the Antarctic circumploar vortex
OPPENHEIMER MICHAEL
ENV DEFENSE FUND, NY,
NATURE, AUG 20, 87, V328, N6132, P702(3)

RESEARCH ARTICLE UNUSUAL BEHAVIOR OF STRATOSPHERIC AEROSOL COINCIDED WITH RECENT MEASUREMENTS OF ENHANCED OZONE DEPLETION IN SPRINGTIME IN THE ANTARCTIC CIRCUMPOLAR VORTEX. ENHANCED CONCENTRATIONS OF CONDENSATION NUCLEI (CN) WERE OBSERVED ABOVE 20 KM. SOME PHOTOCHEMICAL MODELS PREDICT ELEVATED HYDROXYL RADICAL CONCENTRATIONS IN THE VORTEX. HIGH HYDROXYL RADICAL CONCENTRATIONS PROVIDE A SUFFICIENT SOURCE OF CN THROUGH REACTION WITH CARBONYL SULFIDE TO ACCOUNT FOR THE OBSERVED INCREASE IN CN MASS. OTHER MECHANISMS FOR CN ENHANCEMENT ARE INCONSISTENT WITH TIMESCALES OR THE VERTICAL STRUCTURE INFERRED FROM AEROSOL OBSERVATIONS. THE CN ENHANCEMENT OFFERS PARTIAL SUPPORT FOR PHOTOCHEMICAL MODELS OF O 3 DEPLETION IN THE VORTEX. (ENV)

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Polar stratospheric clouds and the Antarctic ozone hole
POOLE, LAMONT R.; MCCORMICK, M. PATRICK (NASA, Langley Research Center, Hampton, VA)
National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
Journal of Geophysical Research (ISSN 0148-0227), vol. 93, July 20, 1988, p. 8423-8430.
Publication Date: Jul. 1988 41 Refs.

A theoretical model for the formation and growth of polar stratospheric clouds (PSCs) has been developed. Results for the calculated temperature dependence of optical backscattering are found to agree well with values obtained during two Arctic airborne-lidar experiments. Results for

PSC formation in Antarctica show that at the 70-mbar level, about 80 percent of the HNO3 and about 30 percent of the H2O vapor available may be sequestered in relatively large PSC particles at a temperature near 189 K. (AER)

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Reactions on ice crystals

PYLE, JOHN (Cambridge University, England)

Nature (ISSN 0028-0836), vol. 334, July 28, 1988, p. 297.

Publication Date: Jul. 1988

The rapid loss of ozone above the South Pole has worsened since its discovery in 1985. Strong Antarctic zonal winds characteristically produce a cold air mass in the lower stratosphere that is chemically isolated from lower latitudes; the depletion of ozone by chlorine atoms occurs in this vortex by a catalytic cycle, in which stratospheric clouds' ice crystals are now thought to furnish the sites of crucial heterogeneous reactions freeing chlorine. Attention is also given to the results of measurements made in 1988 in the Arctic stratosphere, which indicate the presence of chemical conditions favorable to the depletion of ozone. (AER)

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Influence of polar stratospheric clouds on the depletion of Antarctic ozone

SALAWITCH, ROSS J.; WOFSY, STEVEN C.; MCELROY, MICHAEL B. (Harvard University, Cambridge, MA)

Harvard Univ., Cambridge, Mass.

Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 871-874.

Publication Date: Aug. 1988 29 Refs.

Contract No.: NAGW-1230; NSF ATM-84-13153

Precipitation of nitrate in polar stratospheric clouds (PSCs) can provide a significant sink for Antarctic stratospheric odd nitrogen. It is argued that the depth of the Ozone Hole is sensitive to the occurrence of temperatures below about 196 K. An increase in the prevalence of temperatures below 196 K would enhance ozone loss by increasing the spatial extent and persistence of PSCs, and by decreasing the level of HNO3 that remains following PSC evaporation. Concentrations of halogen gases in the 1960s and earlier were insufficient to support major ozone loss, even if thermal conditions were favorable. (AER)

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Overview of the polar ozone issue

SOLOMON, SUSAN (NOAA, Aeronomy Laboratory, Boulder, CO); SCHOEBERL, M. R. (NASA, Goddard Space Flight Center, Greenbelt, MD)
National Oceanic and Atmospheric Administration, Boulder, Colo. Geophysical Research Letters (ISSN 0094-8276), vol. 15, Aug. 1988, p. 845, 846.
Publication Date: Aug. 1988 15 Refs.

The causes of the Antarctic ozone depletion are discussed together with the role of the polar stratospheric clouds (PSCs, which are ice clouds that form towards spring over Antarctica in the altitude range of 10-20 km) in the process of ozone depletion. Evidence is presented suggesting that heterogeneous chemical reactions occurring on the surfaces of the PSCs could dramatically deplete the abundances of reactive nitrogen compounds and enhance those of reactive chlorine species which are responsible for ozone depletion. It was also shown that the surface reactions are not limited to ice clouds but can also take place on the liquid sulfuric acid aerosols present at lower latitudes, indicating that heterogeneous chemistry may take place to some extent on a global scale. Finaly, observations of low-abundance NO2 in north polar regions suggests that heterogeneous removal of reactive nitrogen may well be occurring in the Arctic, with possible attendant applications for Arctic ozone. (AER)

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Reaction of chlorine nitrate with hydrogen chloride and water at Antarctic stratospheric temperatures

Tolbert, M.A.; Rossi, M.J.; Malhotra, R.; Golden, D.M.
Dep. Chem. Kinet., Chem. Phys. Lab., SRI Int., Menlo Park, CA 94025, USA SCIENCE (WASH. VOL. 238, NO. 4831, pp. 1258-1264, Publ.Yr: 1987

Laboratory studies of heterogeneous reactions important for ozone depletion over Antarctica are reported. The reaction of chlorine nitrate (ClONO sub(2)) with H sub(2)O and hydrogen chloride (HCl) on surfaces that simulate polar stratospheric clouds (ice and nitric acid (HNO sub(3))-ice and sulfuric acid) are studied at temperatures relevant to the Antarctic stratosphere. The reaction of ClONO sub(2) on ice and certain mixtures of HNO sub(3) and ice proceeded readily. The sticking coefficient of ClONO sub(2) on ice of 0.009 plus or minus 0.002 was observed. A reaction produced gas-phase hypochlorous acid (HOCl) and condensed-phase HNO sub(3); HOCl underwent a secondary reaction on ice producing dichlorine monoxide (Cl sub(2)O). In addition to the reaction with H sub(2)O, ClONO sub(2) reacted with HCl on ice

to form gas-phase chlorine (Cl sub(2)) and condensed-phase HNO sub(3). Essentially all of the HCl in the bulk of the ice can react with ClONO sub(2) on the ice surface. (POL)

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Antarctic ozone hole: complex picture emerges
ZURER PAMELA S.
CHEMICAL & ENGINEERING NEWS, NOV 2, 87, V65, N44, P22(4)

JOURNAL ARTICLE A RECENT NASA AIRCRAFT EXPEDITION OVER THE ANTARCTIC PROVIDED INFORMATION THAT APPEARS TO CONFIRM THE HYPOTHESIS THAT CHLORINE RADICALS DERIVED FROM CHLOROFLUOROCARBONS (CFCS) ARE RESPONSIBLE FOR THE DESTRUCTION OF THE STRATOSPHERIC OZONE LAYER. HOWEVER, CL PHOTOCHEMISTRY ALONE DOES NOT EXPLAIN THE ENTIRE PHENOMENON. PRELIMINARY DATA SUGGEST THAT BOTH CHEMICAL AND METEOROLOGICAL PROCESSES ARE RESPONSIBLE FOR PERTURBING ANTARCTIC O3. A KEY QUESTION IS WHETHER THE HETEROGENEOUS REACTIONS THAT SEEM TO BE PLAYING AN ESSENTIAL ROLE IN THE CHEMICALLY PERTURBED REGIONS OF THE O 3 HOLE COULD ACCOUNT FOR THE LESS DRAMATIC LOSS OF O 3 OBSERVED OVER MID-LATITUDES. (ENV)

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C. TRACE GAS EMISSIONS/ATMOSPHERIC CONCENTRATIONS

The Potential impact on atmospheric ozone and temperature of increasing trace gas concentrations

BRASSEUR, G.; DERUDDER, A.
Institut d'Aeronomie Spatiale de Belgique, Brussels.
Publication Date: 1987 100P.
Publication Note: Sponsored in cooperation with the Belgian National Fund for Scientific Research and NSF
Report No.: NASA-CR-182965; NAS 1.26:182965; AERONOMICA-ACTA-A-322-1987; ISSN-0065-3713; ETN-88-92484

The response of the atmosphere to emissions of chlorofluorocarbons (CFCs) and other chlorocarbons, and to increasing concentrations of other radiatively active trace gases such as CO2, CH4, and N2O is calculated by a coupled chemical-radiative transport one-dimensional model. It is shown that significant reductions in the ozone concentration and in the temperature are expected in the upper stratosphere as a result of increasing concentrations of active chlorine produced by photodecomposition of the CFCs. The ozone content is expected to increase in the troposphere, as a consequence of increasing concentrations of methane and nitrogen oxides. Due to enhanced greenhouse effects, the Earth's surface should warm up by several degrees. The amplitude and even the sign of future changes in the ozone column are difficult to predict as they are strongly scenario-dependent. An early detection system to prevent noticeable ozone changes as a result of increasing concentrations of source gases should thus be based on a continuous monitoring of the ozone amount in the upper stratosphere rather than on measurements of the ozone column only. Measurements of NOx, Clx, and HOx are also required for unambiguous trend detection and interpretation. (AER)

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Submillimeter measurement of stratospheric chlorine monoxide

CARLI, B.; MENCARAGLIA, F. (CNR, Istituto di Recerca sulle Onde Elettromagnetiche, Florence, Italy); CARLOTTI, M. (Bologna, Universita, Italy); DINELLI, B. M. (CNR, Istituto di Spettroscopia Molecolare, Bologna, Italy); NOLT, I. (NASA, Langley Research Center, Hampton, VA; Oregon, University Eugene) Consiglio Nazionale delle Ricerche, Florence (Italy).
Journal of Geophysical Research (ISSN 0148-0227), vol. 93, June 20, 1988, p. 7063-7068.
Publication Date: Jun. 1988 18 Refs.

The measurement of the ClO concentration in the stratosphere provides crucial information on the mechanism for ozone depletion by catalytic reactions involving chlorine. Two rotational transitions of ClO, J = 35/2 -33/2 and J = 37/2-35/2 have been identified in balloon-borne high-resolution spectra of the stratospheric emission in the submillimeter region. The measurements provide information on the ClO concentration at altitudes around 28 km. In the case of afternoon measurements obtained in April 1979, a scaling factor of 0.85 (+0.67, -0.64) is observed, and in the case of afternoon and early morning measurements obtained in October 1982, a scaling factor of 0.88 (+0.18, -0.08) is observed. (AER)

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An Important uncertainty in coupled chlorine-carbon dioxide studies of atmospheric ozone modification

ECKMAN R.S.; HAIGH J.D.; PYLE J.A.
UNIV OF CAMBRIDGE, UK,
NATURE, OCT 15, 87, V329, N6140, P616(5)

RESEARCH ARTICLE CALCULATIONS ARE PRESENTED USING A TWO-DIMENSIONAL ATMOSPHERIC MODEL OF THE EFFECT ON STRATOSPHERIC OZONE OF INCREASES IN THE ATMOSPHERIC ABUNDANCES OF CO 2 AND VARIOUS CHLORINE-CONTAINING COMPOUNDS. SUCH CALCULATIONS HAVE BEEN CARRIED OUT PREVIOUSLY BUT CHANGES IN THE KINETIC DATA USED IN THE MODEL HAVE LED TO SIGNIFICANT DIFFERENCES IN THE CALULATED OZONE MODIFICATION. THE LOWER STATOSPHERE NOW PLAYS AN EVEN MORE CRUCIAL ROLE IN THE VERTICALLY INTEGRATED OZONE DEPLETION. (ENV)

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Future emission scenarios for chemicals that may deplete stratospheric ozone

Hammitt, James K.; Camm, Frank; Connell, Peter S.; Mooz, William E.; Wolf, Kathleen A.; Wuebbles, Donald J.; Bamezai, Anil
RAND CORP, CA,
NATURE, DEC 24, 87, V330, N6150, P711(6)

JOURNAL ARTICLE LONG-TERM EMISSIONS OF SEVEN OF THE MOST IMPORTANT ANTHROPOGENIC CHEMICALS THAT MAY DEPLETE OZONE ARE PROJECTED. THE CORRESPONDING EFFECT ON STRATOSPHERIC O 3 CONCENTRATIONS IS COMPUTED WITH A ONE-DIMENSIONAL ATMOSPHERIC MODEL. THE SCENARIOS ARE FOUNDED ON DETAILED ANALYSES OF MARKETS FOR PRODUCTS THAT USE THESE HALOGENATED COMPOUNDS AND CHLOROFLUOROCARBONS AND SPAN A CENTRAL 90% PROBABILITY INTERVAL FOR THE CHEMICALS' JOINT EFFECT ON CALCULATED O 3

ABUNDANCE, ASSUMING NO ADDITIONAL REGULATIONS. THE EMISSION LEVELS CONSIDERED SUGGEST THE CHLOROFLUOROCARBON-11 AND -12 WILL CONTINUE TO BE THE COMPOUNDS MOST LIKELY TO CONTRIBUTE TO ANY FUTURE O 3 DEPLETION. (ENV)

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Assessing the Risks of Trace Gases That Can Modify the Stratosphere. Volume 6. Technical Support Documentation Production Projections

Hoffman, J.S.

Environmental Protection Agency, Washington, DC. Office of Air and Radiation.

Corp. Source Codes: 031287620

Report No.: EPA/400/1-87/001F

Dec 87 349p

See also Volume 5, PB88-191879, and Volume 7, PB88-231089.

Also available in set of 8 reports PC E99, PB88-231048.

The document is one of a series that examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. The volume includes reports on: Probabilistic projections of chlorofluorocarbon consumption; Scenarios of chlorofluorocarbon use: 1985-2075; Product uses and market trends for potential ozone depleting substance 1985-2000; and An analytic method for constructing scenarios from a subjective joint possibility distribution. (NTIS)

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Future Concentrations of Stratospheric Chlorine and Bromine

Hoffman, J.S., and Gibbs, M.J.

Environmental Protection Agency, Office of Air and Radiation, August 1988.

This report presents a method for evaluating risks that avoids the uncertainties currently involved in linking atmospheric chlorine and bromine levels and projected ozone depletion. Instead, it relates rates of emissions to stratospheric levels of chlorine and bromine. The report also examines the reductions in potential ozone depleters needed in order to stabilize the atmosphere at current levels of chlorine and bromine. The chlorine levels associated with various changes in the coverage, timing, and stringency of the Montreal Protocol are also projected. (HQL)

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Extremely low N2O concentrations in the springtime stratosphere at McMurdo Station, Antarctica

PARRISH, A. (New York, State University, Stony Brook); DE ZAFRA, R.L.; JARAMILLO, M.; CONNOR, B.; SOLOMON, P.M. (Millitech Corp., South Deerfield, MA); et al.
State Univ. of New York, Stony Brook.

Nature (ISSN 0028-0836), vol. 332, March 3, 1988, p. 53-55. Research supported by the Chemical Manufacturers Association, NSF, Navy, and NASA. Publication Date: Mar. 1988 21 Refs.

Measurements have been made of stratospheric N2O using the Stony Brook millimeter-wave remote sensing spectrometer at McMurdo Station, and NO2 mixing ratios are found that are less than 1.5 at 20 km and less than 1.10 at 25 km compared to values measured during the Antarctic summer. The observed mixing ratios are also much less than those predicted by global-scale models of stratospheric chemistry and dynamics. As the NO2 signal remained very weak when McMurdo was at the edges of the ozone hole and showed no signs of recovering during October, it is concluded that the geographical and temporal extent of the region of low NO2 is comparable to or greater than that of the ozone hole. These results argue against theories that require springtime upwelling to explain the Antarctic ozone hole. It is suggested that the air in the Antarctic lower stratosphere during late winter and early spring has been subjected to considerable downward transport. (AER)

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III. RISK ASSESSMENT

A. HUMAN HEALTH EFFECTS

Effects of Changes in Stratospheric Ozone and Global Climate, Volume 2: Stratospheric Ozone
Environmental Protection Agency and United Nations Environment Program. October 1986.

This document is part of a four volume report that examines the possible consequences of projected changes in stratospheric ozone and global climate resulting from emissions of chlorofluorocarbons, carbon dioxide, methane, and other gases released by human activities. In June 1986, the United Nations Environment Programme and the U.S. Environmental Protection Agency sponsored an International Conference on the Health and Environmental Effects of Ozone Modification and Climate Change, which was attended by scientists and officials, representing twenty-one countries from all areas of the world. (HQL)

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Assessing the Risks of Trace Gases That Can Modify the Stratosphere. Volume 1. Executive Summary
Hoffman, J. S.
Environmental Protection Agency, Washington, DC. Office of Air and Radiation.
Corp. Source Codes: 031287620
Report No.: EPA/400/1-87/001A
Dec 87 101p

The document is one of a series that examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. It provides a synopsis of current understanding of how atmospheric composition may change and the effects the change is likely to have on ozone abundance and its vertical distribution. It includes the impacts of the changes in ozone on human health, polymers, plants and aquatic systems. It also examines related changes in climate and the potential impacts of climate change on sea level rise, agriculture, human health, water resources and forests. (NTIS)

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Assessing the Risks of Trace Gases That Can Modify the Stratosphere. Volume 3: Chapters 6-18

Hoffman, J. S.

Environmental Protection Agency, Washington, DC. Office of Air and Radiation.

Corp. Source Codes: 031287620

Report No.: EPA/400/1-87/001C

Dec 87 566p

The document examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. (NTIS)

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Ultraviolet Radiation and Melanoma: With a Special Focus on Assessing the Risks of Stratospheric Ozone Depletion

Hoffman, J.S.; Longstreth, J.D.

Environmental Protection Agency, Washington, DC. Office of Air and Radiation.

Corp. Source Codes: 031287620

Report No.: EPA/400/1-87/001D

Dec 87 560p

The document is part of a series of documents that examines the human health, environmental and atmospheric effects associated with a decrease in stratospheric ozone. The volume, in particular, addresses the effects to human health and the relationship between ultraviolet radiation and melanoma. (NTIS)

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Human Exposure to Ultraviolet Radiation. Risks and Regulations

Int Congr Ser; 744:1-580 1987

Proceedings of the seminar, Human Exposure to Ultraviolet Radiation, Risks and Regulations, held in Amsterdam, March 23-25, 1987, are presented. The effects of ultraviolet radiation on human health were discussed; in particular, risks associated with the actual exposures were examined, protection against exposure was studied, and the regulations proposed or in existence in different countries were discussed. About 75 contributions, presented at the seminar, are included in these proceedings. The plenary discussions were also recorded and are summarized here. The papers covered the following topics: man and ultraviolet radiation; biological effects -- fundamentals, skin, eyes, and risks; human exposure levels; principles and techniques of protection; and policies and regulations. General discussions have been combined and are reported at the end of these proceedings. A number of recent developments and

concerns generated a need for this conference. The possible depletion of the atmospheric ozone layer with its accompanying increase in levels of ambient UV radiation raised the question of the impact of UV radiation on the environment and on public health. Furthermore, in industrialized countries, people spend more and more time outdoors in sunny locations and ski resorts and a non-negligible part of the population uses sunbeds and similar appliances to get a tanned skin. The increased UV exposure related to this trend may result in more skin carcinomas, and some people worry that the rising incidence of malignant melanoma is due to more UV radiation received by the skin. (MED)

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Impact of ozone depletion on skin cancers

Kripke ML
Department of Immunology, University of Texas M.D. Anderson Cancer Center, Houston 77030.

J Dermatol Surg Oncol Aug 1988, 14 (8) p853-7, ISSN 0148-0812 Journal Code: HZA

Because of recent growth in the uses and production of certain chlorofluorocarbon compounds, the ozone layer is at risk of diminishing. The major effect of a decrease in ozone will be an increase in the amount of UV-B radiation in sunlight. Even a small increase in UV-B radiation will almost certainly affect human health. The most obvious effect of increased UV-B radiation will be an increase in the incidence of basal and squamous cell carcinomas. Other possible effects include a contribution to the development of cutaneous melanoma, ocular changes leading to the formation of cataracts, and immunologic perturbations. (MED)

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Cutaneous Malignant Melanoma and Ultraviolet Radiation: A Review

Longstreth, J

Cancer Metastasis Rev; 7(4):321-33 1988

Cutaneous malignant melanoma (CMM) rates have been increasing in the United States at an average rate of about 4% per year. In 1987, it was estimated that there would be 25,800 cases and 5,800 deaths from CMM in the United States. The exact cause of the increase in unknown, but there is evidence to suggest that increasing exposure to the ultraviolet B (UVB) radiation present in sunlight may be partly responsible. The evidence includes: 1. the fact that higher CMM incidence rates are observed in people with lesser amounts of skin pigment (which blocks penetration of UV); 2. a correlation of

higher CMM rates with decreasing latitude and increasing UVB levels; 3. the observation that freckles and nevi (precursors to CMM) are induced by solar exposure; 4. differences in CMM rates between natives and immigrants to sunny climates; 5. high rates of CMM in patients who cannot repair UVB-induced DNA damage; and 6. the indication that sun exposure at early ages and of an intermittent nature results in higher CMM risks. With the concern that depletion of stratospheric ozone could result in increasing levels of UVB, it has become important to understand the relationship between UVB and CMM in order to estimate the increases in CMM that would be expected with ozone depletion. When empirical relationships between UVB and CMM incidence and mortality rates were derived and used to estimate the impact of stratospheric ozone depletion, a 1% depletion of ozone was predicted to result in increases of 1%-2% in CMM incidence and 0.8%-1.5% in CMM mortality. (CAN)

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The EPA Assessment

SEIDEL STEPHEN R.

EPA, DC

ASHRAE J, NOV 87, V29, N11, P32(2)

JOURNAL ARTICLE EPA RECENTLY COMPLETED A COMPREHENSIVE ASSESSMENT OF THE HUMAN HEALTH AND ENVIRONMENTAL RISKS FROM OZONE DEPLETION. CONTINUED WORLDWIDE USE OF CHLOROFLUOROCARBONS (CFCS) IS CONCLUDED TO LEAD TO FUTURE DEPLETION OF THE O 3 LAYER. RECENT DISCOVERY OF THE ANTARCTIC O 3 HOLE, AND EVIDENCE THAT CHLORINE CHEMISTRY MAY BE RESPONSIBLE, ARE REASONS FOR GREATER URGENCY AND CONCERN. AN ADDITIONAL 141 MILLION CANCER CASES AND 2.9 MILLION DEATHS WOULD RESULT AFFECTING THE POPULATION TODAY AND BORN BEFORE 2075 IF CURRENT GLOBAL USE OF CFCS CONTINUES. ADDITIONAL RESEARCH AND INTERNATIONAL COOPERATION ARE REQUIRED TO ACCELERATE THE TRANSITION AWAY FROM CFCS AND HALONS. (ENV)

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The Ozone depletion problem - Montreal protocol is a major triumph for UNEP

Usher, P.

UNEP

SENTINEL VOL. 5, NO. 1, pp. 5-6, Publ.Yr: 1988

The issue of ozone depletion and its effects can be simply stated. The low concentration of ozone gas found in the stratosphere filters out much of the ultraviolet radiation from the sun which is known to be harmful to biological systems. UV causes cancers in man, induces cataracts, skin diseases and damages the body's immune system. Animals,

terrestrial and aquatic organisms and plants would also be susceptible to UV damage if ozone should deplete. Pollution problems such as acid rain would exacerbate and plastics and other materials degrade when subjected to increased UV. (POL)

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B. TERRESTRIAL AND AQUATIC ORGANISMS

In Antarctica, New Threats to the Fragile Web of Life
Brody, Jane.
New York Times, February 14, 1989.

Due to drastic depletion of the protective ozone layer in the atmosphere and rising pollution of a once pristine habitat, scientists are stepping up their studies of vulnerable creatures that are the foundation of the antarctic food chain. (HQL)

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Fragile Life Under the Ozone Hole
El-Sayed Z.
Natural History, October, 1988. pp. 72-80.

Increased ultraviolet radiation may be weakening the primary link in the antarctic food chain. (HQL)

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Ultraviolet radiation levels during the Antarctic spring
FREDERICK, JOHN E.; SNELL, HILARY E. (Chicago, University, IL) Chicago Univ., Ill.
Science (ISSN 0036-8075), vol. 241, July 22, 1988, p. 438-440. Publication Date: Jul. 1988 10 Refs.
Contract No.: NAGW-873

The decrease in atmospheric ozone over Antarctica during spring implies enhanced levels of ultraviolet (UV) radiation received at the earth's surface. Model calculations show that UV irradiances encountered during the occurrence of an Antarctic 'ozone hole' remain less than those typical of a summer solstice at low to middle latitudes. However, the low ozone amounts observed in October 1987 imply biologically effective irradiances for McMurdo Station, Antarctica, that are comparable to or greater than those for the same location at December solstice. Life indigenous to Antarctica thereby experiences a greatly extended period of summerlike UV radiation levels. (AER)

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As Ozone Is Depleted, Much of Life Could Go With It
Shabecoff, Philip
New York Times, April 17, 1988.

Destruction of the atmosphere's protective layer will leave the earth and all the life upon it increasingly exposed to damaging ultraviolet radiation from the sun which could lead to substantial changes in ecosystems. (HQL)

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Assessing the Risks of Trace Gases That Can Modify the Stratosphere. Volume 8. Technical Support Documentation Ozone Depletion and Plants
Teramura, A.H.
Environmental Protection Agency, Washington, DC. Office of Air and Radiation.
Report No.: EPA/400/1-87/001H
Dec 87 138p

The document is one of a series that examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. It focuses on issues and uncertainties in assessing the effects of UV-B radiation on plants as well as risks to crop yield resulting from an increase in solar UV-B radiation. Recommendations are made for improving field experimental design and management. (NTIS)

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Assessing the Risks of Trace Gases That Can Modify the Stratosphere. Volume 5. Appendix B
Tirpak, D. A.
Environmental Protection Agency, Washington, DC. Office of Air and Radiation.
Report No.: EPA/400/1-87/001E
Dec 87 159p

The report is a summary integration, and interpretation of the current scientific understanding of the effects of potential global climate change in the areas of forest and vegetation, agriculture, water resources, and human health. The appendix is a multi-authored review of the scientific literature on the effects of global climate change. Direct effects of CO2 are generally not included because they have been recently reviewed elsewhere. The document was designed to provide supplementary information for use by the Environmental Protection Agency (EPA) as it assesses the impact of chemicals on the stratospheric ozone layer. (NTIS)

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Stratospheric Ozone Reduction, Solar Ultraviolet Radiation and Plant Life

Worrest, Robert C., and Caldwell, Martyn M. (eds)
Springer-Verlag Berlin Heidelburg 1986.

Proceedings of the NATO Advance Research Workshop on The Impact of Solar Ultraviolet Radiation Upon Terrestrial Ecosystems: 1. Agricultural Crops held at Bad Windsheim, Germany, September 27-30, 1983. (HQL)

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IV. PUBLIC POLICY

A. INTERNATIONAL

The UNEP Agreement
COX J. E.
ASHRAE J, NOV 87, V29, N11, P31(1)

JOURNAL ARTICLE THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER, SIGNED BY EEC AND 24 NATIONS IN SEPTEMBER 1987, ESTABLISHES FUTURE RESTRICTIONS ON THE AVAILABILITY OF FULLY HALOGENATED CHLOROFLUOROCARBONS (CFCs). ON JULY 1, 1989, A FREEZE AT 1986 PRODUCTION AND CONSUMPTION LEVELS OF FIVE CFCS WILL TAKE EFFECT; A SIMILAR FREEZE AT 1986 LEVELS ON THREE OTHER CFCS WILL TAKE EFFECT IN JULY 1992. IN THE YEAR FOLLOWING JULY 1, 1988, EACH NATION WILL REDUCE ITS CALCULATED LEVEL OF CFC CONSUMPTION TO 50% OF 1986 LEVELS. ABOUT FOUR YEARS AFTER THE EFFECTIVE DATE OF THE AGREEMENT, IMPORTS OF PRODUCTS CONTAINING THE IDENTIFIED CFCS FROM NONSIGNATORY NATIONS WOULD BE BANNED. (ENV)

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Politics of the ozone layer: the recent international agreement on ozone depletion marks a new level of cooperation, but tougher standards are needed
Doniger, David D.
Issues in Science and Tech 4:86-92 Spring '88, bibl

Accord signed by 24 nations in Montreal, Sept. 1987. Argues that the nations of the world must move beyond the accord to policies that will stop ozone depletion, not just slow its acceleration. (PAIS)

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Does the Montreal Protocol go far enough?
Environmental Forum 5:14-16 Jl/Ag '88

Four perspectives on the international accord of Sept. 1987, that proposes to reduce chlorofluorocarbon production 50 percent by 1998. (PAIS)

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The Canadian control program to protect the ozone layer
Leah, T.D.
Environ. Canada, Ottawa, Ont. K1A 0H3, Canada
81. APCA Annual Meeting & Exhibition Dallas, TX (USA) 19-24 Jun 1988 81. APCA ANNUAL MEETING & EXHIBITION p. 145, Publ.Yr: 1988

The Montreal Protocol on Substances that Deplete the Ozone Layer sets out a detailed set of regulatory control obligations that must be met by Parties. Environment Canada is considering a full range of control options for meeting these obligations. The domestic regulatory control program will be in two phases. Plan I will put in place a regulation that ensures that Canada meets the specific regulatory requirements for the Protocol. The author describes each option in the context of application, responsibilities imposed upon government and industry, advantages and disadvantages. A control options report which will offer for comment the Government of Canada views on Phase II control measures will be circulated later this year. Some of the measures under consideration are discussed. (POL)

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Can we close the ozone hole? thirty-one nations could soon agree to limit the use of chemicals that are destroying stratospheric ozone

Rowland, F. Sherwood.
Tech R 90:51-8 Ag/S '87, il diag

Contents: Ozone's effect on radiation; Raising the earth's temperature; The Antarctic ozone hole; International regulation moves ahead. (PAIS)

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Montreal Protocol on Substances that Deplete the Ozone Layer
United Nations Environment Programme. September 1987

The Montreal Protocol is a landmark environmental agreement to protect the ozone layer. Based on 1986 consumption levels, the treaty mandates a 50% cut in CFC levels in 1998 and a freeze in halon in 1992. (HQL)

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B. DOMESTIC

Environmental Momentum Picks Up Again
Conservation Foundation Letter, Nov-Dec 86 (8)

NEWSLETTER ARTICLE AS THE 100TH CONGRESS CONVENES, THE OUTLOOK FOR STRENGTHENING ENVIRONMENTAL PROTECTION STATUTES APPEARS MORE FAVORABLE THAN ITS HAS BEEN FOR SOME YEARS. CHIEF INDICATIONS OF AN ENVIRONMENTAL RESURGENCE ARE THE CONGRESSIONAL ELECTION RESULTS OF NOVEMBER 1986, AND A HIGH DEGREE OF ENVIRONMENTAL CONCERN REVEALED IN ELECTION RESULTS, INITIATIVES, AND POLLS. PROBLEMS AWAITING CONSIDERATION INCLUDE TOXIC AIR CONTAMINANTS, MOBILE SOURCE POLLUTION, OZONE DEPLETION, AND ACID RAIN. THEY COULD BE DEALT WITH SEPARATELY OR IN A MORE COMPREHENSIVE SET OF AMENDMENTS TO THE CLEAN AIR ACT OF 1977. A REFURBISHED FEDERAL WATER POLLUTION CONTROL ACT OF 1977 WAS VETOED BY PRESIDENT REAGAN; THIS LEGISLATION WOULD FOR THE FIRST TIME HAVE ATTACKED THE NONPOINT SOURCE PROBLEM. MAJOR AMENDMENTS TO THE SUPERFUND LAW STRENGTHEN THE HAZARDOUS WASTE CLEANUP PROGRAM AT EPA. (ENV)

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Regulatory Impact Analysis
Environmental Protection Agency, Office of Air and Radiation, Office of Program Development, Stratospheric Protection Program, August 1988.

The Regulatory Impact Analysis (RIA) document reflects comments received on the proposed regulation, "Protection of Stratospheric Ozone," Proposed Rule, 40 CFR Part 82, December 14, 1987, and on the draft RIA, and is the final RIA accompanying the Final Rule, which was complete on August 1, 1989. The document is contained in three volumes. Volume 1 contains the RIA document itself. Volume 2 contains appendices to the RIA document and volume 3, in ten parts, contains addenda to the RIA which examine specific CFC and/or halon use sectors. (HQL)

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Protection of Stratospheric Ozone; Final Rule; 40 CFR 82
Environmental Protection Agency.
Federal Register, 40 CFR Part 82, Part 3, Vol. 53, No. 156, August 12, 1988.

Domestic regulations implementing the mandates of the Montreal Protocol. (HQL)

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Protection of Stratospheric Ozone; Advance Notice of Proposed Rulemaking

Environmental Protection Agency.

Federal Register, 40 CFR Part 82, Part 4, Vol. 53, No. 156, August 12, 1988.

Outlines possible future regulatory action, including recycling and labelling. (HQL)

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Impact on Ozone Attainment of CFC (Chlorofluorocarbon) Controls Used to Prevent Future Depletion of Stratospheric Ozone

Harmon, D.L.; Smith, N.D.

Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.

Corp. Source Codes: 034680076

Report No.: EPA/600/D-88/074

The paper discusses the impact on ozone attainment of chlorofluorocarbon (CFC) controls used to prevent future depletion of stratospheric ozone. It has been decided that allocated quotas offer the most attractive approach to limiting the use of CFCs and brominated compounds (halons). This approach should provide for economically efficient reductions. It involves a minimum of administrative costs, is the most easily enforced option, and does not raise any potential legal issues that might result from other options. Control options that might be used by industry to achieve the necessary CFC reductions are evaluated in the Regulatory Impact Analysis (RIA). The most likely long-term control option which may be adopted by most application areas is a chemical substitute. With this option, it may be possible to eliminate 90% or more of the ozone-depleting CFC emissions. A variety of control options hold promise for short-term applicability. Some of the engineering controls may still be applied even after new chemical substitutes (e.g., HFC-134a and HCFC-123) are in use, since the higher cost of these substitutes may justify recovery. EPA is also considering the development of specific regulations limiting CFC and halon use for particular industries to supplement allocated quotas. (NTIS)

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Overview of Controls for Chlorofluorocarbons
Harmon, D.L. ; Rhodes, W.J.
Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
Corp. Source Codes: 034680076
Report No.: EPA/600/D-88/100
May 88 14p

The paper gives an overview of controls for chlorofluorocarbons (CFCs). Responding to concerns regarding the potential for stratospheric ozone depletion, the U.S. has joined other nations in pursuing an international agreement to limit the emissions of fully halogenated CFCs and certain halons. To implement the Montreal Protocol in the U.S., the EPA has proposed a national regulation to limit the production of these substances by the allocation of production quotas to firms engaged in this activity in 1986. Many ways exist to achieve the needed reductions. The paper discusses the various control options with some advantages and disadvantages, for the major industries that use CFCs and halons. (NTIS)

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Ozone layer depletions: hearing, March 9, 1987
United States. House. Com. on Energy and Commer. Subcom. on Health and the Environment.
'87 iv+656p, il tables diag charts
SERIES: 100th Cong., 1st sess.; Serial no. 100-7; SD cat. no. Y 4.En 2/3:100-7;

Suspected role of chlorofluorocarbons in atmospheric ozone depletion; potential impact on human and animal health, agriculture and plant life; implications for an international and U.S. environmental policy. (PAIS)

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Stratospheric ozone depletion: hearings, March 10 and 12, 1987
United States. House. Com. on Science, Space, and Tech. Subcom. on Natural Resources, Agric. Research, and Environment.
'88 iii+317p, il tables charts
SERIES: 100th Cong., 1st sess.; (Pubn.) no. 53; SD cat. no. Y 4.Sci 2:100/53;

Issues surrounding international control of chlorofluorocarbons (CFCs) production. (PAIS)

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Global environmental change research: hearing, July 16, 1987, before the Subcommittee on Science, Technology, and Space and the National Ocean Policy Study, on global climate change due to manmade changes in the earth's atmosphere

United States. Senate. Com. on Commer., Science, and Transportation. '87 iii+152p, charts maps
SERIES: 100th Cong., 1st sess.; S. hearing 100-301; SD cat. no. Y 4.C 73/7:S.hrg.100-301;

Some emphasis on ozone depletion. (PAIS)

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Stratospheric ozone depletion and chlorofluorocarbons: joint hearings, May 12-14, 1987, on the effect of chlorofluorocarbons on stratospheric ozone, health effects of ozone depletion, and substitutes for ozone depleting chemicals, before the Subcommittees on Environmental Protection and Hazardous Wastes and Toxic Substances

United States. Senate. Com. on Environment and Public Works. '87 v+677p, tables charts
SERIES: 100th Cong., 1st sess.; S. hearing 100-201; SD cat. no. Y 4.P 86/10:S.hrg.100-201;

Health threats to the global population; finding suitable substitutes for the chemical pollutants; evaluating U.S. government efforts at control while promoting coordinating action on a global scale. (PAIS)

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Stratospheric ozone depletion: joint hearing, March 30, 1988, before the Subcommittees on Hazardous Wastes and Toxic Substances and Environmental Protection

United States. Senate. Com. on Environment and Public Works. '88 iii+146p, tables charts
SERIES: 100th Cong., 2d sess.; S. hearing 100-628; SD cat. no. Y 4.P 96/10:S.hrg. 100-628;

Explores the recent findings by NASA; efforts to reduce the production of chlorofluorocarbons; development of refrigerant substitutes; and the health effects of the reduction of stratospheric ozone. (PAIS)

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Ozone depletion, the greenhouse effect, and climate change: hearings, June 10 and 11, 1986

United States. Senate. Com. on Environment and Public Works. Subcom. on Environmental Pollution.

'86 iii+326p, bibl tables diags charts maps

SERIES: 99th Cong., 2d sess.; S. hearing 99-723; SD cat. no. Y 4.P 96/10-S.hrg.99-723;

Implications for U.S. domestic and international policy responses. The likely timing and magnitude of predicted climate changes and the risks they pose. (PAIS)

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V. CHEMICAL USE SECTORS: SUBSTITUTES AND ALTERNATIVES

Findings of the Chlorofluorocarbon Substitutes International Committee.
Air and Energy Engineering Research Laboratory.
U.S. Enviromental Protection Agency, April 1988.

This report presents the results of the International Committee's findings in investigating substitutions of suspect CFCs with more environmentally benign chemicals. Discussed are such matters as the necessary steps remaining to commercialize leading candidate substitutes, identification of several secondary candidates, and additional research needed to resolve uncertainties. (HQL)

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AT&T Finds CFC Substitute
NOT MAN APART-FOE, JAN-FEB 88, V18, N1, P1(2)

JOURNAL ARTICLE CHLOROFLUOROCARBON-113 (CFC-113) IS ONE OF THE MOST WIDELY USED CFCS AND CONTRIBUTES TO THE DESTRUCTION OF THE STRATOSPHERIC OZONE LAYER. A NATURAL SOLVENT IN ORANGES THAT WILL ELIMINATE THE NEED TO USE THIS CHEMICAL IN SEVERAL IMPORTANT MANUFACTURING PROCESSES HAS BEEN DEVELOPED BY AT&T AND PETROFERM INC., FL. BIOACT EC-7 WAS ADAPTED BY AT&T RESEARCHERS FROM A CHEMICAL DEVELOPED BY PETROFERM FOR USE AS A FLAVORING AND PERFUME AGENT INTO A SOLVENT FOR USE IN CLEANING SOLDER FLUXES ON ELECTRONIC CIRCUIT BOARDS. EPA TOUTS THE CFC-113 SUBSTITUTE AS AN IMPORTANT DEVELOPMENT THAT ALLOWS MANUFACTURERS TO CLEAN SURFACE MOUNTED ELECTRONICS COMPONENTS WITH A CHEMICAL THAT DOES NOT DEPLETE STRATOSPHERIC O3. (ENV)

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Implication of CFCs on Environmental Quality and Opportunities for Engineering Solutions
Anderson, S.O.; Lupinacci, J.M.
Internl Journal of Refrigeration, Vol. 11, No.4, July 1988.

Refrigeration and air conditioning accounts for over 35% of all CFC end uses in the USA. Refrigeration engineers have quickly and responsibly moved forward in their efforts to protect the ozone layer. This paper describes the proposed international and domestic regulation, the engineering and commercializiation accomplishments to date, and outlines the tasks still before us. (HQL)

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Halons, Stratospheric Ozone and the U.S. Air Force
Andersen, S.O., M.J. Ryan, J.L. Walker, R.E. Tapscott, and E.T. Morehouse.
The Military Engineer, No. 523, August 1988, p. 485-492.

Chemicals which have been used successfully to protect life and property and considered relatively safe - the halon firefighting agents - may now deplete ozone and pose very serious dangers to life on earth. This article explains the significance of the problem, the global response and international efforts to mitigate the impacts, the co-operation taking place between a wide variety of U.S. organizations, and what innovation steps the Air Force is taking to protect the environment. (HQL)

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Motor Vehicles as Sources of Compounds Important to Tropospheric and Stratospheric Ozone
Black, F.M.
Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Sciences Research Lab.
Corp. Source Codes: 034680077
Report No.: EPA/600/D-88/067
Apr 88 30p

One of the most rapidly growing human activities in the U.S. of importance to atmospheric ozone is the use of highway motor vehicles. Transportation sources are estimated to have been responsible for about 34% of 1985 U.S. anthropogenic hydrocarbon emissions, 70% of carbon monoxide emissions, 45% of nitrogen oxide emissions, 24% of nonaerosol chlorofluorocarbon emissions, and 14% of carbon dioxide emissions. Data is presented describing possible uninventoried transportation hydrocarbon emissions that could increase their estimated contribution to 45 -50% of the anthropogenic total. Data is also presented suggesting motor vehicles to be relatively insignificant sources of anthropogenic nitrous oxide, but noting that these emissions are increased by the control technologies used to reduce hydrocarbon, carbon monoxide, and nitrogen oxides emissions. The sensitivity of motor vehicle emission rates and compositions to such operating variables as ambient temperature, altitude, and average speed is discussed. (NTIS)

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Impact of CFC (Chlorofluorocarbon) Restrictions of US Building Foundation Thermal Performance

Christian, J.

Oak Ridge National Lab., TN.

Sponsor: Department of Energy, Washington, DC.

Report No.: ORNL/CON-245

Dec 87 72p

A significant increase in the use of foundation insulation had been expected as a result of the near completion of ASHRAE 90.2P, New Building Energy Efficiency Standard, and the publication of several Department of Energy foundation design tools. Potential restrictions on the future availability and/or price of chlorofluorocarbon (CFC)-12 will have a potentially substantial impact on the goal of improving the efficiency of building foundations. One of the better ways to insulate foundations is on the exterior in contact with the earth, and one of the better insulating products for this application is extruded polystyrene (XEPS). According to some personnel in the Environmental Protection Agency, it is likely that because XEPS is currently blown with CFC-12 and since CFCs could be a major contributor to anticipated future ozone depletion, some restrictions are imminent. The work statement for this analysis called for an initial impact analysis on energy conservation goals and a foundation research plan to mitigate the impacts of restricting the use of CFCs in foundation insulation systems. This report addresses quantitatively the energy-saving impacts at the state level of CFC restrictions on foundation insulation and concludes that the total impact could be anywhere from near zero to 0.8 quad in the year 2010, with the most likely impact being about 0.13 quad/year. The risk of high impacts can be reduced by an accelerated research effort focused on developing and demonstrating insulated foundation systems that have overall performance equivalent or superior to that of exterior XEPS insulated basement walls, crawl space walls and slab-on-grade systems. (NTIS)

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CFC Footprint

Denny, R. J.

Air-Conditioning & Refrigeration Inst, Arlington, VA, USA

Source: ASHRAE Journal v 29 n 11 Nov 1987 p 24-28

Publication Year: 1987

Until now there probably was no such term as a CFC footprint, so for convenience, one has been invented to describe a graphical plot of some properties of a CFC. In order, let's (1) define a few common terms such as 'halogens' associated with CFCs; (2) show the different molecular structures of CFC-12 and CFC-22 and why they are important to the ozone depletion theory; (3) discuss the 'family' of CFCs; (4) show some of the variables that must be considered in designing a

liquid chiller system for keeping storage warehouses cold; (5) point out why CFC-22 is part of the solution and not a part of the problem; (6) state the air conditioning industry's position on CFC regulations; and (7) name a refrigerant you can inhale and one you can swallow. (CPX)

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Halon 1301 Discharge Testing: A Technical Analysis
DiNenno, Philip J., and Budnick, Edward, K.
Prepared by National Fire Protection Research Foundation for the Environmental Protection Agency, October 1988.

This report summarizes the results of a literature review and analysis on the technical issues and alternatives to Halon 1301 total flooding system discharge tests. (HQL)

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CFCs and Stratospheric Ozone - Fact Sheet
Environmental Protection Agency, Office of Public Affairs. December 1987.

Stratospheric ozone acts as a shield against harmful solar ultraviolet radiation. Reductions in the total abundance of stratospheric ozone could pose human health risks and reduce crop yields and alter terrestrial and aquatic ecosystems. A consensus has emerged worldwide that chlorine from synthetic chemicals called chlorofluorcarbons will decrease ozone in the stratosphere. To protect the ozone layer, an international treaty was negotiated in Montreal, Canada, in September 1987. (HQL)

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Proceedings of Conference and Trade Fair: Substitutes and Alternatives to CFCs and Halons
Environmental Protection Agency, Office of Air and Radiation. April 1988

On January 13-15, 1988, the U.S. Environmental Protection Agency, Environment Canada, and the Conservation Foundation sponsored a conference and trade fair on alternatives and substitutes to chlorofluorocarbons (CFCs) and halons. Organized as part of the effort to implement the Montreal Protocol and reduce global dependence on ozone-depleting substances, the conference focused on ways to facilitate the transition ot new chemicals, technologies and products. (HQL)

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How Industry is Reducing Dependence on Ozone-Depleting Chemicals
Environmental Protection Agency, Office of Air and Radiation. June 1988.

As concern over ozone depletion has grown, industries have begun finding ways to become less dependent on chemicals that deplete ozone. This publication discusses alternatives being explored in each of the chemical's major use areas. (HQL)

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A Down-to-Earth Job: Saving the Sky
Gannes, Stuart
Fortune v 117 n 6 PP: 133-141 Mar 14, 1988

Chlorofluorocarbons (CFC) are a group of widely used chemicals that are blamed for a destructive effect on the earth's stratospheric ozone layer. A treaty signed in 1987 by 24 countries, including the US, requires restrictions on CFC production starting in 1989. As the supply of CFCs shrinks, the cost will escalate. Consumers will pay more for such items as home refrigerators, and some companies, such as makers of foam insulation, may not be able to remain profitable. As a result, CFC manufacturers are spending millions of dollars in research to discover less harmful, nontoxic substitutes. Du Pont alone spent $10 million in 1987 on substitute development. The race is on to find and produce CFC substitutes fast enough to fill the gap that will be created by limits on CFC production. (ABI)

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Ozone-Layer Pact Could Change Halon Use
Gallup, James G.
National Underwriter (Property/Casualty/Employee Benefits) v92n33 PP: 16-17 Aug 15, 1988

The international response to the scientific discovery of atmospheric ozone depletion in Antartica may have a significant impact on the use of halon in fire protection. In September 1987, representatives from 57 countries developed a global response to the issue of ozone depletion, the effects of which may include increased incidents of skin cancer, cataracts, immune system suppression, and a greenhouse effect that could produce a substantial rise in sea level. The Montreal Protocol on Substances That Deplete the Ozone Layer, which goes into effect on January 1, 1989, requires that total halon production be limited to 1986 production levels. Other chlorofluorocarbons, which appear to contribute to ozone depletion, will be more severely limited in that production will be reduced by 30% by 1998. Plans by the Environmental Protection Agency to enforce the

protocol could include permits, production quotas, or economic incentives. (ABI)

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A Treaty to Ground CFCs May Push Prices Upward
Goldbaum, Ellen; Hunter, David; MacKerron, Conrad B.; Ushio, Shota
Chemical Week v141n14 PP: 6-8 Sep 30, 1987

An agreement reached by the representatives of 24 nations, including the US, is designed to freeze, then curb the production and use of chlorofluorocarbons (CFC) in order to protect the earth's ozone layer. The Montreal Protocol on Substances That Deplete the Ozone Layer is seen as a means of spurring the development of substances that could be substituted for CFCs. The protocol centers on CFCs used primarily as refrigerants, blowing agents, and cleaning agents, and substitutes are likely to include other CFCs that do not endanger the ozone level. Most of the compounds that currently show promise are, on average, 5-8 years from commercialization, and they are expected to cost 2-4 times as much as existing CFCs. One option already on the market is Pennwalt's 142b/22, a blend of CFC 142b and CFC 22. It currently is priced at $1.73 per pound, compared to 65c per pound for the banned CFC 12. Several of the world's largest producers are collaborating to conduct the necessary long-term toxicological tests. (ABI)

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The Terpene Hydrocarbon Alternative
Hayes, Michael
Printed Circuit Assembly, March, 1988. p.19.

It is necessary to identify alternatives to the use of chloinated and chlorofluorcarbon solvents wherever possible. This paper examines the terpene alternative. (HQL)

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Implications of the Montreal Protocol for Atmospheric Emissions of Alternative Chemicals (Rept. for Jan-Mar 88)
Hummel, K.E.; Smith, N.D.; Harmon, D.L.
Radian Corp., Austin, TX.
Sponsor: Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
Report No.: EPA/600/D-88/146
Aug 88 30p

The paper is about alternative chemicals. The substitution, of less ozone-depleting chemicals wherever it is cost

effective and technically feasible, is expected because of anticipated future limitations on production and consumption of the fully halogenated chlorofluorocarbons (CFCs) and halons (fluorocarbons containing bromine atoms) covered by the Montreal Protocol. Certain alternative chemicals (e.g., HCFC-22 and methyl chloroform) are already used in applications other than as CFC substitutes. Projected future consumption of alternative chemicals includes such non-substitution use. Study results indicate that the 50 percent reduction in weighted CFC/halon consumption (weighted for ozone depletion potential) required by the Protocol in 1998 could initially be achieved by alternative chemicals alone. However, alternative processes or products not requiring either the controlled substances or their substitute chemicals and/or substantial recovery and reuse of the chemicals would be needed to maintain the 50 percent level of reduction in the longer term. (NTIS)

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How Long a Farewell to CFC Production?
MacKerron, Conrad B.
Chemical Week v142n14 PP: 7-8 Apr 6, 1988

While Du Pont has stated that it supports the Montreal Protocol cutting production of chlorofluorocarbons (CFC), the firm has been resisting efforts to completely ban the manufacture of CFCs. Recently, however, Du Pont changed its policy, urging that the 50% cut in CFC production agreed to in the Protocol be extended to 100%, committing itself to total phaseout of CFC production. This change in attitude is a result of scientific studies indicating that the erosion of the earth's ozone layer is up to 4 times more rapid than previously suspected. On March 15, 1988, NASA reported that total ozone depletion was an average of about 2.5%, with winter decreases reaching up to 6.2%, depending on the latitude. Legislation has been introduced in the US Senate that would mandate CFC emission cuts of 95% within 8 years, a target that Du Pont's Joseph M. Steed says would be difficult to reach. He notes that CFC replacements in refrigerated components still are 5 years away from the marketplace, the minimum time required for toxicity testing. (ABI)

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The ARI position
MCGUIRE JOSEPH M.
AIR CONDITION & REFRIGERATION INST, VA,
ASHRAE J, NOV 87, V29, N11, P36(2)

JOURNAL ARTICLE THE AIR CONDITIONING & REFRIGERATION INST (ARI), A NATIONAL TRADE ASSOCIATION REPRESENTING

MANUFACTURERS OF REFRIGERATION SYSTEMS, HAS APPROVED A FORMAL POSITION ON THE REGULATION OF CHLOROFLUOROCARBONS (CFCS). BECAUSE OF THE UNCERTAINTY REGARDING POSSIBLE STRATOSPHERIC OZONE DAMAGE DUE TO CFC EMISSIONS, RESPONSIBLE ACTION ON THE PART OF THE GOVERNMENT AND INDUSTRY IS WARRANTED. ARI CONTENDS THAT GLOBAL ACTION IS THE ONLY RESPONSIBLE WAY TO DEAL WITH THE ISSUE, AND THAT SUFFICIENT TIME MUST BE MADE FOR INDUSTRY TO PREPARE FOR EVENTUAL CFC SUBSTITUTES BEFORE EXISTING CFCS ARE PHASED OUT. RESTRICTIONS SHOULD BE LIMITED TO THE FULLY HALOGENATED COMPOUNDS CFC-11, CFC-13, AND CFC-113. (ENV)

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CFCs (Chlorofluorocarbons): Is the Sky Falling. Quest for Alternatives (Final rept.)

McLinden, M.O.; Didion, D.A.

National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment Div.

Sponsor: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA.

1988 11p

Pub. in ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Jnl., p32-42 Dec 87.

The objectives of the article are to present the criteria required of a refrigerant, discuss the reasons why CFCs (chlorofluorocarbons) were originally investigated as refrigerants (reasons which also make them the most promising in the search for alternatives) and finally to demonstrate that the inevitable tradeoffs among the various alternatives can be treated in a systematic way. (NTIS)

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Decline of the CFC Empire

Monastersky, Richard

Science News, Vol 133, April 9, 1988. pp. 234-236.

An industry is scrambling to prepare for the next decade when the United States and other nations will have to cut their use of these ubiquitous chemicals at least in half. (HQL)

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International Conference on Fire Protection Halons and the Environment - Summary

National Fire Protection Association. August 22, 1988.

Some 270 conference participants from 23 countries met in Lugano, Switzerland from June 28-29, 1988, to address the halon/ozone issue. Six keynote papers were presented during

the opening session, setting the stage for consideration of the environmental challenge, critical fire protection applications for the halons and possible near term alternatives. Seventeen papers were given in three other speaker sessions. (HQL)

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The Elusive Replacements for CFCs
Pool, Robert
Science, Vol 242, Nov. 4, 1988. pp. 666-668

As CFCs are phased out to protect the ozone layer, Chemical companies scramble to find substitutes for these vital compounds and to develop economical ways to make them in large quantities. (HQL)

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Implications of the Montreal protocol for atmospheric emissions of alternative chemicals
Smith, N.D.; Harmon, D.L.; Hummel, K.E.
Environmental Protection Agency, Research Triangle Park, NC 27711, USA
81. APCA Annual Meeting & Exhibition Dallas, TX (USA) 19-24 Jun 1988 81. APCA ANNUAL MEETING & EXHIBITION p. 144, Publ.Yr: 1988

Anticipated future limitations on production of the fully-halogenated chlorofluorocarbons (CFCs) and halons covered by the Montreal Protocol is expected to prompt substitution of these compounds with alternative, less ozone-depleting chemicals. This paper explores the extent to which alternative chemicals may find substitution in various applications and the ramifications of such substitution on future atmospheric emissions. Alternative chemicals such as HCFC-22 and methyl chloroform are already employed in several applications. Projected consumption of such alternative chemicals includes their non-substitution usage. (POL)

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Service Shops Caught in Planetary Threat of Ozone Depletion
Stephenson, Stan
Motor Age, April, 1988. pp. 38-46.

The automotive refrigerant R-12 (Freon) is one of a group of CFCs which has been identified as contributing to a seious health threat. We may have to capture and recycle refrigerant now used in A/C systems in cars and trucks. (HQL)

****

Pros and Cons of Halon 1301; But Will It Give Us Skin Cancer?
Stoffels, Bob
Telephone Engineer & Mgmt v92n19 PP: 39-47 Oct 1, 1988

Halon 1301 is a suppression agent that acts to break up the chemical reaction of fire. It reacts over and over again to stop the chemistry of combustion, and it is able to put out a fire without harming equipment or personnel. Halon 1301 leaves no residue and under most circumstances does not damage contacts. Upon discharge, it immediately vaporizes and mixes rapidly with the entire atmosphere inside the protected space. However, Halon 1301 is very expensive. Thousands of dollars worth of it is required to protect a switch room adequately. Halons and chlorofluorocarbons (CFC) have been blamed for the depletion of the Earth's stratospheric ozone layer. The US Environmental Protection Agency has proposed restrictions on the use of both CFCs and halons. The restrictions on halons will not be as great as on CFCs because of their value in protecting high value operations from fire. Nevertheless, halons must be used in a responsible manner to reduce unwanted emissions. (ABI)

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EPA, U.S. Producers Grapple with Ozone Depletion
Usdin, Steven
Manufacturing Week n24 PP: 11 Jan 25, 1988

The Environmental Protection Agency (EPA) is trying to help US companies sort out the alternatives to ozone-depleting chlorofluorocarbons (CFC) before laws that regulate their use take effect on August 1, 1988. Many companies have developed practical alternatives, but some industries and environmental groups indicate the proposals pose new problems. Environmental groups are fighting the EPA's plan to allocate quotas to restrict production of CFCs and predict that CFC manufacturers will reap windfall profits as supplies decline. AT&T Co. and Petroferm Inc. have developed a nontoxic solvent to replace CFC-113 in cleaning fluids for printed electronic circuit boards and wiring boards. The EPA has helped companies become aware of the potential of the compound, called BIOACT EC-7. One area in which alternatives may be several years away is CFC-based insulation in refrigerators and freezers. (ABI)

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Formulating away from CFCs. Part I: The whys and wherefores.
Weisfeld, Lewis B.
Source: Plastics Compounding v 11 n 2 Mar-Apr 1988 5p

Plastics foam producers are beset by serious threats to their businesses on two fronts. First, forthcoming legislation and regulation are certain to curtail the use of their most economical (and some say essential) blowing agents, the chlorofluorocarbons. Secondly, consumer activists are calling for a complete ban on foamed plastics packaging itself. The article examines the historical basis of the dilemma and the government regulatory consequences. (CPX)

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Control Technology Overview Report: CFC (Chlorofluorocarbon) Emissions from Rigid Foam Manufacturing (Final rept. Mar-Nov 86)
Wert, K.P.; Nelson, T.P.; Quass, J.D.
Radian Corp., Austin, TX.
Sponsor: Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
Report No.: EPA/600/2-88/003
Jan 88 199p

The report estimates total chlorofluorocarbon (CFC) emissions from the various rigid foam manufacturing processes and from the foam products themselves, and examines potential methods for reducing these emissions. Options studied include replacement of CFC-blown products with alternative products not requiring CFCs, replacement of ozone-depleting CFCs with other chemicals less likely to destroy stratospheric ozone, and recovery/recycle of CFCs released during manufacturing processes. In the production of rigid cellular foams, CFCs are used as physical blowing agents to reduce foam density and impart thermal insulating properties. Such rigid foams include polyurethane, polystyrene, polyethylene, polypropylene, polyvinyl chloride, and phenolic foams. Uses of these foams include building insulation, packaging materials, and single-service dinnerware. Depletion of stratospheric ozone through action of halocarbons, particularly CFCs, has been the subject of extensive study and wide debate. Although many uncertainties remain, current scientific evidence strongly suggests that anthropogenic CFCs could contribute to depletion of the stratospheric ozone layer as was first postulated in 1974. (NTIS)

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Search intensifies for alternatives to ozone-depleting halocarbons

Zurer, Pamela S.

Chemical & Engineering News, Feb 8, 88, V66, N6, P17(4)

JOURNAL ARTICLE THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER WILL FREEZE CONSUMPTION OF CHLOROFLUOROCARBONS (CFCS) AT 1986 LEVELS ON JULY 1, 1989. LATER CUTS IN OUTPUT WILL REDUCE CFC CONSUMPTION FIRST BY 20% BY MID-1993, THEN BY AN ADDITIONAL 30% BY MID-1998. EPA HAS ALSO PROPOSED REGULATIONS THAT WILL CONTROL HALOCARBON OUTPUT IN THE U.S. THROUGH A SYSTEM OF PRODUCTION QUOTAS. THESE PROTOCOLS ARE THE DRIVING FORCE BEHIND THE SEARCH FOR CFC SUBSTITUTES BY CHEMICAL CONCERNS. CHEMICAL CANDIDATES RECEIVING THE MOST ATTENTION AS LIKELY SUBSTITUTES ARE FLUOROCARBONS-123, -134A, AND -141B. ALL THREE CARRY HYDROGEN ATOMS THAT RENDER THEM SUSCEPTIBLE TO DEGRADATION IN THE LOWER REGIONS OF THE ATMOSPHERE, UNLIKE THE FULLY HALOGENATED CFCS. (ENV)

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APPENDIX

MONTREAL PROTOCOL PARTICIPANTS

MONTREAL PROTOCOL PARTICIPANTS

Signatories
Ratifiers

March 8, 1989

Montreal Protocol Participants

Argentina
Australia
Austria
* Belgium
Burkina Faso
* Byelorussian SSR
* Canada
Chile
Congo
* Denmark
* Egypt
* EC
* Finland
* France
* German Dem. Rep.
* Germany, Fed. Rep.
* Ghana
* Greece
Indonesia
* Ireland
Israel
* Italy
* Japan
* Kenya
* Lichtenstein
* Luxembourg
Maldives
* Malta
* Mexico
Morocco
* Netherlands
* New Zealand
* Nigeria
* Norway
* Panama
Philippines
* Portugal
Senegal
* Singapore
* Spain
* Sweden
* Switzerland
Thailand
Togo
* Uganda
* Ukrainian SSR
* United Kingdom
* USSR
* United States
* Venezuela

* Ratified

46 Signatories
36 Ratifiers
March 8, 1989

Entered Into Force January 1, 1989

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